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ENGINEERING NEWS.

THE NICARAGUA CANAL CO. sent out this week its ninth cargo of supplies and railway and canal material, including 60 miles of telegraph wire to complete the line from Greytown to the Nicaraguan Government line at Fort San Carlos on Lake Nicaragua, and one mile of 8-in. steel water pipe for the proposed aqueduct between the Deseado basin and Greytown to supply the eastern terminus of the canal with pure water. We shall next week, we may note in this connection, publish a colored detail profile of the route showing the material as determined by borings. The company is starting slowly, as any such great enterprise should, but we confidently anticipate will soon have the work under vigorous headway.

THREE DAMS ON THE OHIO, to render the river navigable from Pittsburg to Beaver, and a canal from Beaver to Erie, have been proposed with the aim to connect Pittsburg with the great lakes. It is said that the Pennsylvania Legislature has appropriated $100,000 for the making of surveys, and that the Governor will appoint a commission to decide upon the practicability of the project and upon the best route. It is thought that 6,000,000 tons of coal and iron would be shipped to and from Pittsburg over this route.

THE EFFECT OF WATER COMPETITION on freight charges is illustrated by the closing of the Chesapeake & Ohio canal. According to the Washington *Star*, people living along the line of the canal who used to get Cumberland coal at $2.50 per ton now have to pay $5 per ton, being dependent on the railway for transportation.

THE ANTHONY'S NOSE BRIDGE, across the Hudson, is advancing slowly. The West Shore railroad is now moving its tracks back 20 ft. to afford room for the shore pier, at a cost of $100,000, which has been paid by the company: one of the tunnel approaches is being driven, and a wagon road is building to the Anthony's Nose anchorage. Work was started in December, 1887, and has never been entirely suspended since, although at times only a very few men have been at work.

THE CITY OF SYRACUSE, N. Y., is meeting with opposition to its project for a new water supply from Skaneateles lake. The opposition is made by the city of Buffalo and by the New York Produce Exchange, the grounds being that the waters of the lake are needed to feed the Erie canal. A hearing before the State Canal Board was held Aug. 29. Most of the arguments presented were by those in favor of the Syracuse project, and the meeting was adjourned, without decision, until Sept. 23. Those favoring the taking of a water supply from the lake claim that there will be for years to come plenty of water for the needs of city, canal and all others now depending upon this source. Mr. HOWARD SOULE has submitted a report to the Syracuse Water Board in which he gives the results of surveys and examinations which he claims show that there is no reason why Syracuse should not draw upon Skaneateles lake for its supply. It is held by those favoring the project that when there is a lack of water from the lake for canal purposes other sources of supply can be drawn upon by the State, while these other sources are not suitable for the needs of the city's water supply.

THE SPOKANE RIVER, which flows from the Cœur d' Alene lake, Idaho, has a fall of 120 ft. within the limits of the city of Spokane Falls. The flow of the river at its lowest stage is sufficient to produce 30,000 H. P., at the above named fall. This power has been purchased by the Washington Water Power Co., and they have had plans prepared for its full development by Col. J. T. FANNING, of Minneapolis, Minn. Construction of the dam, flumes and wheel pits is to be pushed ahead as rapidly as possible, this autumn. H. A. HERRICK is engaged as resident engineer.

THE BREAK IN THE CANAL at Shelby basin, near Medina, N. Y., has been repaired. A leak in the Cornwall canal at Lock No. 20 near Maple Grove, Ont., caused a slide of the bank, but the contractors at once began strengthening the lock to prevent further damage.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Aug. 31, at Brooksville, Vt., on the Central Vermont railroad. A north bound cattle train failed to stop at New Haven according to orders, and ran into a south bound special excursion train from Rutland. The engineer of the special had heard the other train and reversed his engine, but too late to prevent the accident. The engines and several cars were wrecked. There were three persons killed and five injured. The crew of the freight train are responsible for the accident.—A misplaced switch caused a collision at Adams, Ga., Aug. 28, between two freight trains on the Southwestern railroad (Central of Georgia). A freight train that left Macon was standing on a side track waiting the arrival of an extra freight from Albany. When the extra steamed in sight, the switchman must have been asleep, for he jumped up and set the switch so that the extra left the main line and ran on the side track and plunged into the regular freight. Both engines were damaged and several cars wrecked.—A hand car carrying a number of laborers to work on the Philadelphia & Reading railroad, near Linfield, Pa., was struck by a freight train. One man was killed and five were injured.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: A derailed freight car struck the end post of an iron bridge on the East Tennessee and, Virginia & Georgia Railroad near Newcomb, Tenn., on Aug. 28, and the bridge gave way, throwing 8 cars into the creek—A temporary trestle on the Cape Fear & Yadkin Valley Railroad, near Germantown, N. C., built over a recent washout, gave way under an engine on Aug. 28.—Five trestles on the Oregon Railway & Navigation Co's. line were destroyed by fire on Aug. 27.—A trestle on the Denver & Rio Grande Railroad near Chama, N. M., was destroyed by fire recently—A wooden highway bridge over the Bear river near Maryville, Cal., gave way under a drove of cattle Aug. 23. The timbers were found to be rotten.—The Campbell Ave. bridge at San Francisco, Cal., gave way under a team Aug. 29.

AN EARTHQUAKE shock was felt at Los Angeles, Cal., and in neighboring towns, on Aug. 28.

THE TREASURES OF THE AZTECS are now being sought for by extensive excavations near the city of Mexico, and with some indications of success. There is no doubt that the last Aztec Emperor, QUAUHTEMOC, the recent statue to whose memory we illustrated Feb. 11, 1888, buried immense quantities of gold and silver, variously estimated at from $20,000,000 to $80,000,000 worth, somewhere near Mexico, and stoically refused to reveal their hiding place under the most ingenious tortures, while admitting that he had buried them. Subterranean stairways, passages and vaults, with some valuables, have already been discovered.

A STATE GEOLOGICAL SURVEY of California was begun some time ago, but abandoned with the abolition of the office of State Geologist. The collected data were turned over to the State Minerologist, and it is said that the present incumbent of the latter office, Mr. WM. IRELON, wishes to go on with the work at once, and has made arrangements to do so. Owing to some technical fault in the wording of the bill the $100,000 recently appropriated cannot be used at present.

THE SIMPLON TUNNEL is to be completed by a German company which has been formed, with a capital of $6,000,000. The company has acquired control of the two Swiss railways from Lucerne, and now the whole line connecting Lucerne, Berne, Pontarlier, Geneva, and the Simplon is, like the St. Gothard railway, under German influence, the French directors being replaced. The new company favors an immediate piercing of the Simplon. The company has accepted a scheme for a tunnel at the base of the mountain, with its southern mouth in Italy, and that country will contribute $3,000,000. There is little doubt that the Swiss Government will accept this proposal. The whole plan is of great importance to Germany and Italy commercially.

A TUNNEL UNDER THE HARLEM as a substitute for the McComb's Dam bridge, is among the possibilities. The late Commission appointed to report upon the proposed 155th St. viaduct, made up of Messrs. E. P. VAN WINKLE, THOS. C. CLARKE, G. W. MCNULTY and Gen. JNO. NEWTON, reported against a high bridge or a drawbridge. The tunnel was estimated to be built for $2,000,000. It would be made in two driveways on either side of a center footway. The driveways would be 18 to 20 ft. wide and 15 ft. high. The Park Department inserted in its estimates for 1889 an item of $2,000,000 for this tunnel but it was stricken out by the Board of Apportionment on the ground that legislation was necessary.

A CLASS IN THE THEORY AND PRACTICE OF STEAM ENGINEERING will be held at the Young Men's Institute, 222 and 224 Bowery, New York City, on Wednesday and Friday evenings during the autumn, winter, and spring. The class is intended for firemen, apprentices and engine men, and will be conducted by Mr. WM. H. WEIGHTMAN, M. E. The first session will be held Oct. 2, and the class will continue till April 30. Persons desiring to attend the class should apply at once to Mr. E. C. BALDWIN, Secretary of the Institute. Instruction of this kind is very important now, when so much attention is being paid to the improvement of the steam engine and its economical operation.

A HEAVY BLAST, displacing over 30,000 tons, or some 10,000 cu. yds., was fired at Mr. P. CALLAHAN'S quarry at Selkirk, N. Y., on the evening of Sept. 3. The blast was highly successful, the anticipated displacement having been not much more than 15,000 tons. We shall give further details of this blast later, which was one of the largest ever made in the State.

A WAVE-POWER PUMP has just been put in operation at Ocean Grove, N. J., to supply water for street sprinkling. The device is the invention of N. O. BOND, of Fairfax C. H., Va. A pier was built out into the surf, and on the side toward the ocean were hung 8 gates, swinging on a horizontal rod along their top. Each gate is 13 ft. wide, and its lower edge is immersed about 2 ft. at low tides and 7 ft. at hihg tides. A rocking arm attached to the gate is connected by a rod to a force pump with horizontal cylinder. The water is forced to a tank

about 40 ft. above, from whence it is drawn as needed by the sprinkling carts. Press reports state that on July 26, when two of the gates were first put in operation, 40,000 galls. of water were pumped into the tank. The length of time taken to do this is not stated, but estimating it at 12 hours, each gate would have developed from 20 to 25 H. P. It seems to us hardly likely that a gate of that size would prove so effective an engine. Most probably the tank to which the water was pumped was 40 ft. away from, instead of 40 ft. above, the sea. This supposition is corroborated by an examination of the New Jersey map, which fails to show any elevation in or near Ocean Grove more than 20 ft. in height.

TABLES OF SQUARES.—Mr. E. E. BUCHANAN, of Athens, Pa., writes us that the late notice in this journal of his "Tables of Squares" is not complete enough to show the principal use for which they are intended. He says: They are mainly used for finding the unknown side of a right-angled triangle. A good example would be a triangle in which the base was C B and the perpendicular B A. Then—given the side A B=25 ft. 6½ ins. and C B=12 ft. 8⅛ ins., to find C A. From the tables the square of 25 ft. 6½ ins. is 652.3784+, and the square of 12 ft. 8⅛ ins. is 161.1046+; the sum is 813.4830+, and from the tables the root of this sum is 28 ft. 6¼ ins. Mr. BUCHANAN says these tables are of great use in finding the length of diagonals in bridge, roof, and trestle work, and for machinists and template makers, as well as engineers and calculators.

THE space allowed for expansion on the Forth Bridge is nearly 7 ft., being 1 in. per 100 ft. on the 8,098 ft. of the bridge. It is provided for by halved rails. In spite of great precautions to ensure safety about a man a day has been killed since the work began. There are about 5,000 men employed, drawing about $25,000 weekly in wages ($5 per week only, average.) The workshops cover 50 acres.

Growth of the Electric Railway.

Mr. GEORGE W. MANSFIELD read before the National Electric Light Association at its Niagara Falls meeting, an interesting paper on electric railways, which we abstract as follows:

The steam railroads of the United States, with nearly an equal number of cars and 42 times more road than the street car lines, carried only a quarter as many passengers. The horse cars of the city of New York carry 199,491,735 passengers, almost half as many as are carried by all the steam roads in the United States. If to this number are added those carried by the elevated roads we have a total of 371,021,524, or almost as many passengers are carried in New York City alone as are annually carried by all the steam roads in the whole United States. The street railways of the State of Massachusetts carry over 44,000,000 more people than all the steam roads in that State. One road alone, the West End of Boston, carries nearly 10,000,000 more than all the steam roads combined.

If we figure for each car 6 H. P. of electric energy, it will give a rough idea of the size of an electrical central station needed to operate all the cars. In New York city, dynamo capacity of 13,800 H. P. would be demanded, in Boston 9,504 H. P., and so on. This is destined to come. In Boston it has come, and a station of approximately 8,000 H. P. is already in the hands of the engineers.

Electricity shows already the steady, vigorous growth that inevitably will result in its complete supremacy for street car purposes. The following table shows the increase of electric railways and this does not include the remarkable contract just entered into by the West End road:

	No. Elec. Rys.	Miles of Track.	No. of Cars
1885	3	7.5	13
1886	5	28	39
1887	7	29	81
1888	33	130.5	265
Jan. 1—July 1, 1889	19	113	174
Building, July 1, 1889	42	267	364
Total	109	575	936

An interesting comparison is also afforded in the following table:

	1870	1880	1890
			Estimated
Total H. P., both water and steam, engaged in the whole manufacturing industry of the United States	2,346,142	5,410,837	10,000,000 (?)
Total H. P. engaged in the electric lighting and power industry	—	1,000	500,000
Total H. P. engaged in electric railway industry	—	—	30,000

The Chignecto Ship-Railway.

We give herewith some further details of this novel engineering experiment, which we described n part in our issue of Oct. 27, 1888. We reproduce from that issue the little map below, showing the general location of the railway, which is only 17.06 miles long, and yet saves so great a sailing distance.

Map Showing Location of the Chignecto Ship-Railway.

[Shipping of Bay of Fundy, 1887, 2,618,144 tons with cargo; 1,323,019 tons in ballast; of Gulf and River St. Lawrence from Quebec eastward only, 6,241,164 tons.]

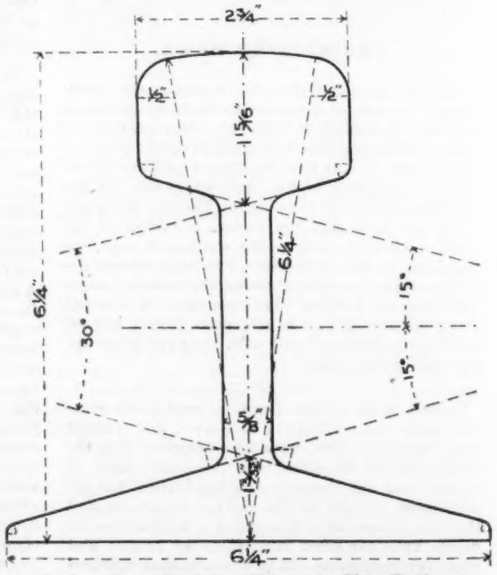
The company estimate that steamers passing from the St. Lawrence to St. John, N. B., via the Straits of Canso, will save 500 miles, and from 300 miles upward to Portland, Boston, etc., so that in many cases steamers should be able to make two trips where now only one can be made. Large sailing vessels, which are unable to pass through the Straits of Canso without waiting for favorable winds, and which have in consequence to pass round Cape Breton, will save 700 miles. Such a saving is of special importance in the case of vessels with perishable cargoes, such as vegetables, fresh fish, etc., and it naturally follows that there will be a saving in marine insurance premiums (the present rates from Boston to ports in the Gulf of St. Lawrence being about double those to the Bay of Fundy, owing to the increased risk of navigation round Nova Scotia and Cape Breton); a longer navigation season (by some three weeks) owing to saving the passage of the Straits of Canso; and less demand for strength in vessels, so that vessels, which from their build are adapted only for inland waters, will be able to continue their course with safety from the St. Lawrence and even the western lakes to St. John, N. B., Portland and Boston, or *vice versa*, thus opening a new channel of trade.

The novel part of the enterprise, of course, is not the mere lifting out of the water and moving for a short distance of the hulls of ships, but the transporting of them for miles at some tolerably high speed, say 10 miles per hour, from one body of water to another. This much disputed possibility is now in a fair way of being put to the proof. The works are already far advanced. Considerably more than a third of the grading is now done, as a result of this season's work. The two terminal basins are being worked on day and night, and the laying of masonry is about to begin; if indeed it has not already begun, since our notes are from a visit made more than a month ago. The rails and hydraulic plant are already delivered and on the ground. About 1,000 men are at work in all, on what our profile shows to be fairly light grading, and unless there should be some unexpected delay in completing the lifts and docks, there seems no reason whatever why the present expectation should not be fulfilled of running a ship over before the close of the 1890 season. The contract date for completion of the work is September, 1890, just two years after the beginning of the contract, and it is fully expected to fulfil this requirement.

We shall at a later date, as soon as the plans are available, give details of the hydraulic plant and cradles. At present, for some inscrutable reason having some remote connection perhaps with a possible ship railway in the vicinity of Panama or Tehuantepec, should this one be successful, and also with the fact that this is the first experiment of the kind, and that some considerable changes of plans may yet prove desirable, the company is unwilling to give out for publication the plans of the lifts, docks and cradles. We are obliged for lack of space to postpone until next week the presentation of the few details as to these features of the project which we are now able to give; but so many much larger plants of the kind are already in use, for dry docking purposes, that the lack of full details is the less to be regretted. It is only proposed to handle on this railway ships of 1,000 tons burden.

The cradle, or gridiron, in which the ships are carried, consists in substance of heavy double transverse girders, carried at each end on trucks of the ordinary passenger pattern, with very easy springs, and of course made very strong and rigid. It is proposed to block up each ship in this cradle, first along the keel, and secondly by wedge-shaped blocks thrown in by levers on each side under the bilge The complicated hydraulic plant proposed by Capt. EADS for this purpose is wholly dispensed with, as unnecessary for small ships at least.

The road bed will consist of two parallel tracks, 18 ft. between centers, and laid to the usual 4 ft. 8½-in. gauge. The rail will be the extra heavy 110 lb. section which we show to half full-size in the accompanying drawing. Being a shade heavier than the Sandberg "Goliath" rail, it is the heaviest rail section ever rolled, and as such has a certain interest of its own. It will be observed to have a very heavy base, vertical sides to head and web, and a rather shallow head in proportion to depth. It has a very short top radius and a very long corner radius, however, and in this respect we think is bad. It is not probable that any great amount of study was be-

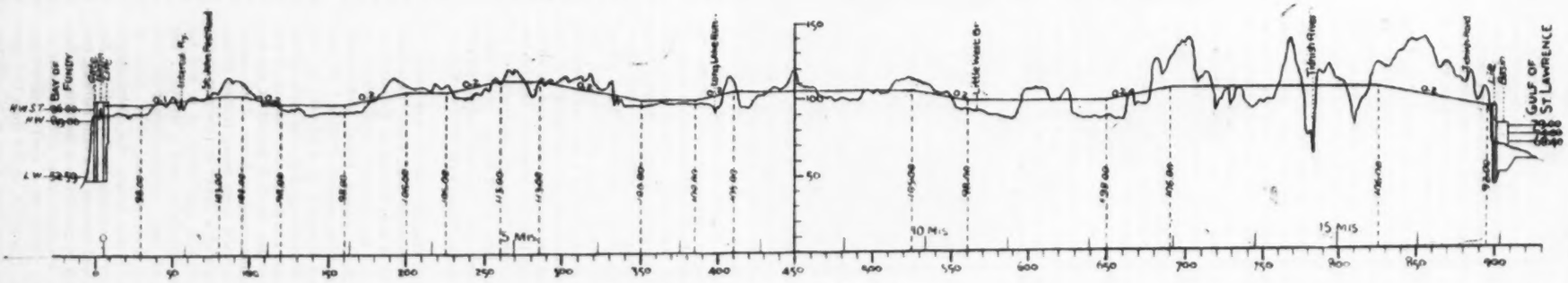


110-lb. Steel Rail for Chignecto Ship-Railway.

stowed on the rail. Further details of road-bed construction will be given next week.

The line from dock to dock, as will be seen from our map, is an unbroken tangent. As will also be seen from our map and profile this admirable feature was not secured because the country was a flat plain over which a straight line could be laid down anywhere. On the contrary, the ground is quite rolling and broken, and a straight line showing the favorable profile which we give was only secured after many trials and much difficulty. The first definite location made over the route was for the old Baie Verte canal project in 1873, and the map shows how crooked that line was. The first definite location for the ship railway is shown by the heavy dotted line, and was much straighter, having but one long compound curve in it. This line was also somewhat shorter, and had a somewhat better profile than the straight line finally adopted, but Mr. KETCHUM finally determined that it was better to

Map of the Chignecto Ship Railway and the two Prior Locations. Sir JOHN FOWLER, BENJAMIN BAKER, and H. G. C. KETCHUM, *Engineers*.



Detail Profile of the Chignecto Ship Railway.

simplify the first experiment of the kind and conciliate doubting Thomases by adopting the air line even at the expense of a slightly heavier profile, the principal loss being the heavy cut at the north end of the canal. The maximum grade is now 0.2 per cent. or 10.56 ft. per mile, and this occurs on 8 different planes, all short, which are connected to the adjacent levels by vertical curves which we have not taken the trouble to reproduce.

The range of mean tides at the Gulf of St. Lawrence end is from 68.4 to 74.0, averaging 71.4, the track being at 92.0, or about 20 ft. above it; spring tides, 5 ft. higher. At the Bay of Fundy end the ordinary range is from 52.6 to 89.0, or 36.4 ft., spring tides rising 7 ft. higher. In this connection we may state that the 70 ft. tides of the Bay of Fundy are somewhat of a myth; the ordinary spring tide range being only about 50 ft., and the extreme about 60 ft. Even this is an enormous fluctuation to occur twice a day, and results in charging the upper end of the bay with an almost incredible amount of earthy matter in suspension, nearly one-third in bulk of the water at times. This being the only available water for feeding a canal was one of the reasons for preferring a ship railway. As will be clear from the profile, it is proposed to reduce the difficulties from these enormous tides, as respects a ship railway by admitting vessels to the basin at half tide or more only. When the tide is high (or at the worst, when it has fallen to half tide again) the gates are closed, and vessels will then have to wait 6 hours or more for the tide to rise again before they can enter the basin.

The soil along the route is for the most part quite favorable, being a compact clayey earth. At points bogs are encountered which have to be excavated and refilled with solid earth. There is a comparatively small amount of rock excavation, and the structures are only a few box and arch culverts such as might be expected from the profile.

The work is heavily subsidized, the Canadian Government paying to the company $170,602 a year for 20 years in half-yearly installments, or about 3.1 per cent. on the authorized capital of $5,500,000, if the ship railway never earns a dollar. The only proviso is that the net earnings including subsidy, shall never exceed $385,000, or $214,398 of earnings only. Should they do so, only enough subsidy to make up the total of $385,000 shall be paid, and should the earnings only ever exceed $385,000, the company is to pay back half the excess until all the subsidy has been repaid. There seems little present danger of either of these limits being reached. The company (or rather the contractors, who took all the stock and bonds) have placed $4,500,000 of preferred stock (in addition to $1,000,000 of common stock) paying 7 per cent. interest thereon until completion and acceptance of the works, and these shares now command a small premium, showing that the works are expected to earn something, since the mere guarantee of 3.1 per cent., for 20 years would by no means make the securities worth par. It requires only $105,000 net earnings, however, to pay 7 per cent. on the preferred stock.

The act authorizing the subsidy was passed in 1882, about two years after Capt. EADS made public his project for a ship railway at Tehuantepec. That project, with the extensive professional endorsement which it called forth, undoubtedly helped largely to secure passage of the act for this ship railway, but it would be a mistake to suppose that the Chignecto project originally sprung from that of Capt. EADS. On the contrary, it was an original idea of Mr. H. G. C. KETCHUM, the resident Chief Engineer and projector of the enterprize. Mr. KETCHUM'S home being in New Brunswick, the question of a canal at this point early attracted his attention and study, as it had various other men's for more than a century; but the difficulties of canal construction were seen to be so great that at last, away back in the '70's, and years before the Tehauntepec, project had been advanced by Capt. EADS, Mr. KETCHUM conceived the idea of a ship railway, prepared plans for it in much the same form as those now in process of construction, and earnestly advocated it in the public press, but for many years without success. Therefore, so far from this project being copied from Capt. EADS, it is quite possible that Capt. EADS may have received his first hint from some sketch of this project, although it is unnecessary to assume anything of the kind. Our only purpose is to secure for Mr. KETCHUM his just credit as the originator of a bold and novel engineering device, which he has at last succeeded in carrying through to a practical result.

In 1886 the original act was amended (increasing the subsidy, we believe); and the "Chignecto Marine Transport Railway Co., Limited" was incorporated by special act, which requires only that the railway shall transmit loaded ships of 1,000 tons burden.

Mr. BENJAMIN BAKER, who is one of the engineers of the work, on July 14, 1888, submitted the following report on the project.

The project for the construction of a ship railway between the Bay of Fundy and the Gulf of St. Lawrence was first brought to my notice by Mr. H. G. C. KETCHUM, the engineer and projector of the undertaking, about four years ago, and I have since that date given a considerable amount of attention to the details of the work. The general question of ship railways was not a novel one to me, as I had previously been consulted by the late Capt. EADS with reference to the Atlantic and Pacific Ship Railway, 140 miles in length, for which he had obtained a concession across the Isthmus of Tehuantepec, and I had expressed the opinion, held also, I may add, by my partner Sir JOHN FOWLER, K. C. M. G., Sir E. J. REED, K. C. B., Sir NATHANIEL BARNABY, K. C. B., and other eminent naval authorities, that there would be no difficulty in lifting ships out of the water and transporting them any distance by rail without injury to themselves on a properly designed car running over a solidly-constructed railway.

In the Autumn of 1886 negotiations for the construction of the Chignecto Ship Railway were in active progress, and it was found desirable for me to inspect personally the site of the proposed works. I arrived at Amherst on Oct. 3, of that year, and proceeded at once with the work of inspection. It is unnecessary for me to report on this in any detail, as no engineering difficulties occur on the line. At Tidnish (at the North end) I found the foreshore at the site of the piers and the proposed hydraulic lifts to be of soft red sandstone, which is a very favorable material, having reference to the character of the works to be executed. At Cumberland Basin I examined the site of the proposed dock and other works at low water and found the foreshore to consist of a firm clay overlaying rock, which also constitute favorable conditions. Along the line of the railway trial pits had been sunk, showing generally the substratum to consist of red clay overlaying sandstone rock, and in places softer materials of limited depth, which would require to be drained and otherwise dealt with in forming the railway.

[Formal letters of approval of plans which we omit.—ED.]

The company states its traffic prospects as follows:

The tonnage for last year entered and cleared at the ports immediately affected by the construction of the railway in the Gulf of St. Lawrence, and in the Bay of Fundy, as certified by Mr. GEORGE JOHNSON, the Dominion Statistician, amounted to 10,182,327 tons, not including the tonnage of ports west of Quebec or Montreal, Portland, Boston, Halifax, and the eastern coast of Nova Scotia, and the United States fishing fleet, estimated at 600 vessels, which it is believed will largely avail themselves of the company's railway. Taking, however, only the moderate amount of 800,000 tons, or in other words, say one-twelfth of the above tonnage, the revenue of the company would represent an income of $500,000, viz.:—800,000 tons of cargo at an average of 50 cts. ($400,000) and 800,000 tons of vessels' hulls at an average of 12 cts. ($96,000). These rates are considered reasonable, and are based on local information.

The working expenses will be very moderate, owing to the line being perfectly straight and nearly level, the speed slow, and coal cheap. These expenses, when the line is worked to its full extent, are estimated by Mr. B. BAKER at only $120,000, which with administration and office expenses (estimated at $30,000,) makes a total of $150,000, leaving a net revenue of $175,000, after paying 5 per cent. on $3,500,000, the authorized debenture capital It is estimated, therefore, that there will be an ample margin to meet the dividend on the preferred and ordinary shares. In winter as well as in summer the company will be able to execute repairs of vessels, from which a further profitable return is anticipated.

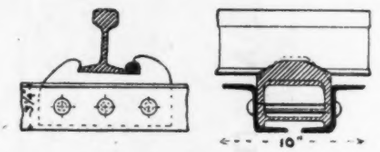
The engineers of the work are the firm of Sir JOHN FOWLER and Mr. BENJ. BAKER, of London, and Mr. H. G. C. KETCHUM, of New Brunswick, the latter acting as resident Chief Engineer. Messrs. JOHN G. MEIGS & Son, of London, are the contractors in chief, Mr. MEIGS being a brother of the HENRY MEIGS of South American fame, an American by birth, but now of London. The firm has executed various heavy contracts in various parts of the world, and take in payment for the work the entire stock and bond capital of the company.

Messrs. Easton & Anderson, Limited, the famous builders of the Malta and other docks, are the sub-contractors for the lifts and hydraulic plant; and Messrs. Dawson, Symmes & Usher are the sub-contractors for all other parts of the work, Mr. JOHN F. O'ROURKE, late of the Poughkeepsie bridge, acting as their engineer. The actual cost of construction is not stated, but it is difficult to see why it should much, if at all, exceed $2,000,000; it certainly cannot exceed $2,500,000, which is about the capitalized present value of the 20 years' subsidy. The subsidy, therefore, amounts practically to a free gift of the works on condition of operating them for 20 years; an arrangement, which seems at first a losing bargain, but which was probably necessary to insure construction, and a not unfair division of probable profits between the undertakers of the enterprise and the general public. We postpone to a following issue some further account of the constructive details.

Z-Iron Railway Ties.

A form of metal cross-tie, which has been in service for about two years in Belgium, consists of two Z-irons placed side by side, forming a sort of trough, with two cast-iron chairs fastened between them. The top flanges project outward, and the lower flanges inward, and each chair is secured by three rivets. The chairs have projecting lugs or ribs on their edges; the outer flange of the rail is slipped under the outer lug, and a taper key is driven between the other lug and the rail flange. The key is split at its small end. The Z-irons present a great resistance to bending, and as the tie is buried in the ballast, it makes a very substantial track.

The Society of Local Railways has adopted these ties on the Charleroi suburban lines. These lines are 9.3 miles long, 1 metre gauge, with grades



Belgian Z-Iron Railway Tie.

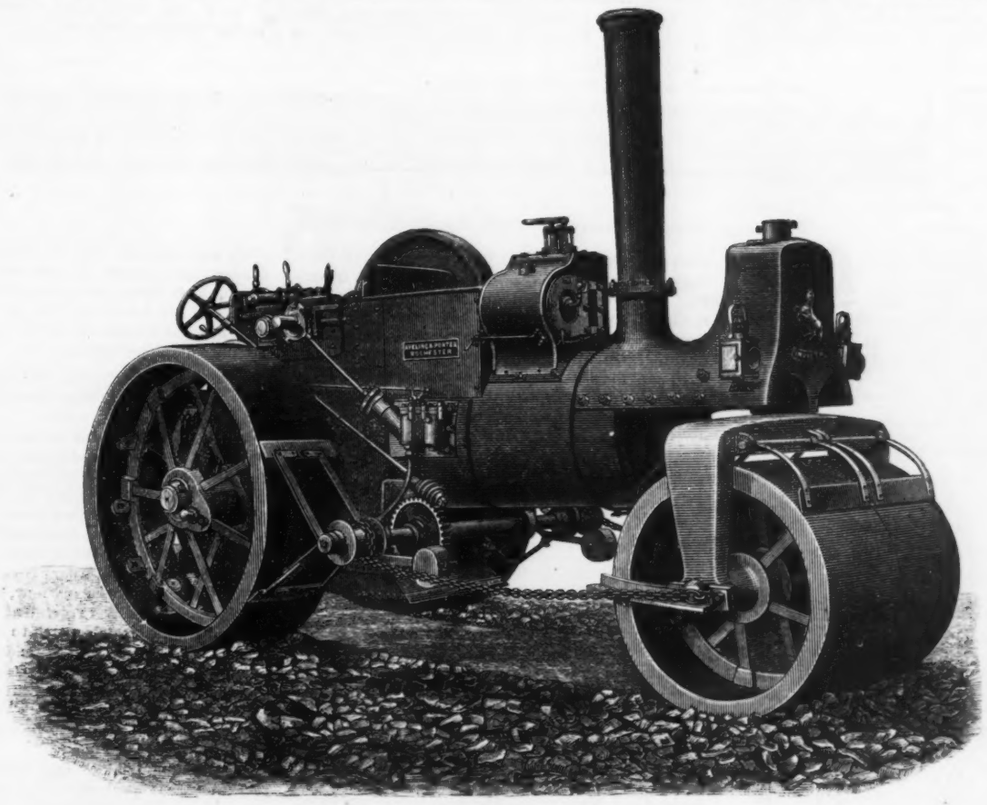
as steep as 6 per cent., and curves of 82 ft. radius; on two of the lines there are 30 trains per day, and on the third line 54 trains. There are 12,829 ties; two forms are used, one where the line is on the waste ground at the side of the road, the other where it is in the roadway; they weigh 114.4 lbs. The lines were opened in June, 1887, and the track has given good results, especially in freedom from noise, owing to the security of the fastenings. M. GRUMIEAUX, the engineer, reported that the passage of trains was as smooth and easy over these ties as over wooden ties; it has been noticed that at crossings, where wooden cross-ties are used, no difference can be detected when the train passes from the metal to the wooden ties.

For standard gauge lines with heavy traffic it is proposed to use ties weighing 209 lbs. The accompanying cuts fully explain the construction of these cross-ties, which seem to have some very good points.

PREVENTING SHEET IRON STACKS FROM RUSTING.—A correspondent in the *Artisan* gives a plan for preventing sheet iron stacks from rusting. He says that if before raising the new chimney, each section, as it comes from the shop, be coated with common coal tar, then filled with light shavings and fired, it will resist rust for an indefinite period, rendering future painting unnecessary. In proof of this he cites a chimney, erected in 1866, and treated as above described, which is to-day as bright as the day it was raised, without having a particle of paint applied since. The theory by which he accounts for this result is that the coal tar is literally burned into the iron, closing the pores and rendering it rust-proof.

The Telford-Macadam Pavement.

For a first-class driveway and road pavement there is probably nothing to exceed in general excellence the class of pavement that combines the meritorious features of the systems of two of the greatest of road engineers of the world, Telford and Macadam, the men to whom England to-day really owes her wonderful network of highways. The materials for such roads abound in the majority of our States, and lack of public appreciation of the true value of properly constructed roads, a mistaken idea of economy, and, in most States, the existence of laws that make and permit bad work, alone stand in the way of a much needed change in the means of intercommunication in our towns and about our towns. But signs of a welcome change are evident in the rapidly growing interest in better laws and better methods, and hence no apology is necessary for taking a leaf from English practice in the construction of Telford-Macadam roads and in again showing how this road is built and some of the tools necessary in its construction.



Aveling & Porter's Steel Steam Road-Roller.

The following specification for a Telford Macadam pavement is prepared by a well-known road engineer of New York from the best practice in this direction, and the interjected notes add greatly to its general value:

The finished pavement, in its cross-section, shall be an arc of a circle, with a rise of 1 in 30, from the curb to the center of the road, each way. The roadway, when consolidated and finished, will be 12 ins. in depth at the gutters, and 15 ins. at the center, diminishing gradually from this point right and left to the depth named. The gutters to be 2 ft. 6 ins. in width, and to be of stone blocks 6 ins. sq. and 6 ins. deep; and to be laid in sand on a firmly consolidated surface of small broken stone or gravel, as shown in plan.

Preparation of the Road-Bed.—The earth road-bed, on which the pavement is to rest, shall be excavated to the required depth, and when graded and shaped to its proper form it shall be thoroughly and repeatedly rolled with the steam-roller, and all depressions which shall then appear are to be filled with the same material as the road-bed and rolled until the whole shall be uniformly compact and firm.

NOTE.—Too much attention cannot be given to the careful preparation of the road-bed. To begin correctly is necessary for ultimate success. It is insufficient that the road-bed be simply smoothed over with loose earth and then built upon; it must be heavily rolled until it is *uniformly* compacted, otherwise the wearing-surface of the pavement will soon follow the unevenness of the subway and wear in waves and undulations, causing an infinity of trouble and expense, which can be avoided by some extra trouble in the earlier stages of the construction of the road. Ploughing up the road-bed should not be allowed. The depths reached by this means are irregular, and uniformity of compactness is made more difficult.

Stone Foundation.—On the road-bed thus formed an compacted, a bottom layer of stone of a depth of 8 ins. at the center of the road, and gradually diminishing to 6 ins. at the curb, is to be set by hand to form a close, firm pavement. The stones are to be laid with their largest side down, in parallel lines across the street, breaking joint as much as practicable. The width of the upper part of the stones not to be more than 8 ins. nor less than 6 ins. The stones not to exceed 15 ins. in length. After being set closely together, the stones are to be firmly wedged by inserting a bar in all possible places and placing between them stones as nearly as possible of the depth of the pavement, until the whole is bound in position. Projections of the upper part of this course shall be broken off, care being taken not to loosen the pavement; and no wedging shall be done within 20 ft. of the face of the work being laid. The small interstices are to be filled in with stone chips firmly wedged with hammers. The whole is to be thoroughly rammed and settled to place, and all undue irregularities of surface broken off.

NOTE.—The purpose of this course of rough stone is not only to secure for the superstructure a permanent and unyielding foundation, but to act also as an open drain through which all superfluous moisture may readily find its way to the proper channel, and thus keep the pavement dry. To this end it is necessary to avoid the filling up of the openings between the stones with anything finer than "chippings." By wedging the stones, and filling in with smaller pieces, the foundation can be made unyielding and firm without being solid. Almost any quality of stone is suitable for this foundation course, and also for the next or intermediate layer. Once properly laid it, needs no renewal, and this permanency of the well made Telford road is a strong recommendation from an economical view. The gutter blocks may be either of trap-rock, or slate, or bluestone slabs, or even small cobble-stones. In New York City blocks of trap-rock have been used. At New Haven gutters of bluestone, 12 in. wide and 4 ins. thick, are used. Some engineers think gutter stones may be dispensed with altogether, except on streets having heavy grades.

Intermediate Layer of Stones.—On the foundation course shall be laid an intermediate layer of broken stones, varying in size from 3 ins. in their greatest diameters to 1 in. in their smallest diameters. These irregular sized stones may be either the "tailings" of the screened stones, or may be raked from the quarry and placed on the roadway without being machine-broken; but they must, nevertheless, be so laid as to compact solidly, and must be clean broken stone, free from dust and dirt, and within the dimensions given above. This intermediate course will be 4 ins. in depth at the center of the roadway, gradually decreasing to 3 ins. in depth at the gutters; it will be thoroughly rolled by the steam roller until it shall be firm, compact, and solid. On its upper surface it shall be identical in rise, and form to the cross-section of the finished pavement as specified above. In the laying of this course of stone a small quantity of binding material will be used, sufficient only to fill up the crevices and render this portion of the pavement solid. Preferably the binding is to be of fine screened gravel or sand, which is to be sufficiently watered during the process of rolling, so that the "licking up" of the road material and its adherence to the rolling-wheels may be prevented.

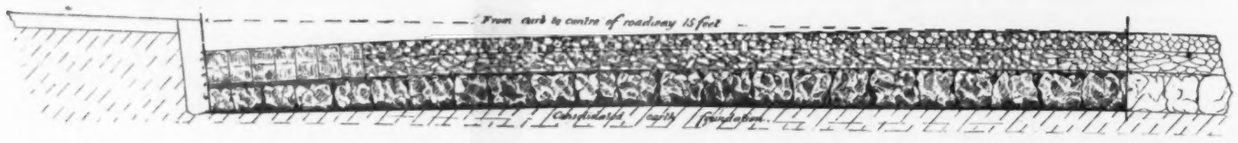
NOTE.—On this course, where no vehicular wear occurs, stones of irregular size may be used and they need not be of the best quality, provided any money saving can be effected by using inferior stone. The object of specifying unscreened irregular stone is to lessen the cost of construction, but every care must be taken to make this course compact and solid. If inferior stones be used, they must not be such as will crush under the weight of the steam roller; neither must they be laid except in such manner as shall insure a close, compact, and solid layer. The watering of the binding material also requires care. The holes in the water-cart tube are generally too large, and are apt to "flush" the material used for binding, and drive it through the layer. A convenient arrangement is to have two tubes and valves to each water-cart, the tubes having different-sized holes.

Surface Layer.—On the intermediate course will be laid the surface layer of broken stone. It will be 3 ins. in depth when consolidated, and the stones shall be practically uniform in quality, and as near an approach to a cube in form as possible. Each stone used in this layer shall have passed through a 2½-in. circular hole, and all stones that are wedge-shaped and do not approach uniformity of measurement on their sides shall be taken from the road with properly shaped rakes, and no stones allowed to remain which are not sound, strong, and equable in size and quality of material. The stones shall be raked into an even layer, and the steam-roller passed over them twice or thrice. After this a quantity of fine screened gravel or sand shall be thrown on, and sufficiently sprinkled to moisten the mass without "licking up." The rolling shall then be continued (working the roller backwards and forwards gradually from the gutter to the crown), with an occasional light watering of the pavement, until the cross-section shall be exact according to specification, the interstices filled in, the roadway firmly compacted and solid, and all excesses of binding removed from the surface of the finished pavement.

NOTE.—If the earth subway, the foundation course,

and the intermediate layer have been carefully laid and thoroughly consolidated, the wear will be confined to the surface of the road, and this alone will require renewal. This is one great feature in the economy of well-built broken-stone pavements. Every other description of pavement, when worn out on its surface, has to be taken up in its entirety, and relaid at a repetition of its first cost.

A well constructed Telford-Macadam pavement can, in most districts, be put down for 85 cts. to $1.25 per sq. yd. The interest alone, on the difference between the cost of stone block or asphalt pavements and the Telford-Macadam, will, without making any appropriation at all for repairs or maintenance, more than pay the annual expense of keeping the Telford road in a continuously good condition; and, be it remembered, in the one case there will be (at the end of the 10 or 20 years, as the case may be,) a good, well-conditioned pavement, requiring only the usual repairs; in the other, there will be no pavement at all but a worn-out one, and on which, if the pavement be renewed, still another outlay equal to first cost will have to be made. The farther the period for comparison is carried, so much the more will it be in favor of the permanent Telford roadway. The conditions for this economy are simply that the roadway shall be well built with proper material and watchfully maintained. Thoroughness in all parts of the work, and the best possible material, of uniform size, for the wearing surface, will insure success. An improved screen for attachment to the crusher has lately been invented, which separates the well-shaped uniform stone from the bulk of broken material. It is a great improvement on the ordinary rotary screen, and can readily be added to any description of stone breaker. It is inexpensive.



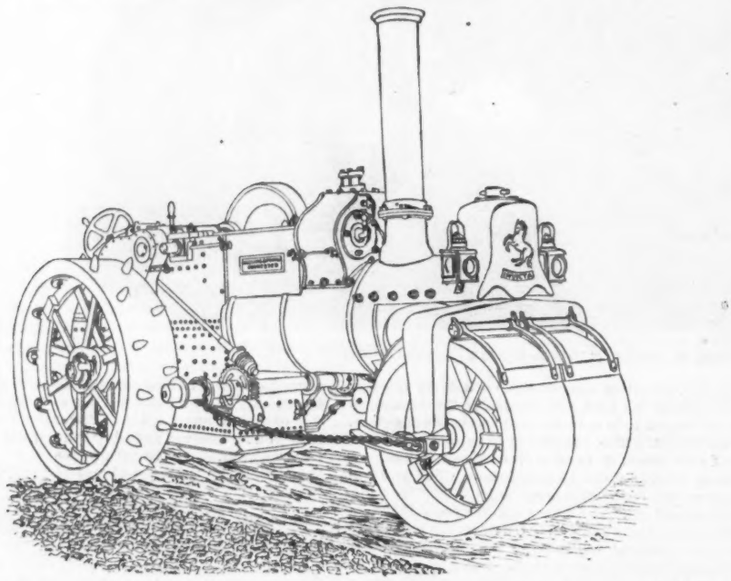
Cross Section of Telford-Macadam Roadway.

In London, where there are 1,800 miles of broken-stone roads, and more than 50 steam rollers, the stone is brought 150 miles, and, when it is delivered ready for use, it costs $4.25 (17 s. 9d.) per cu. yd. This large sum is paid for this particular kind of stone because it is found cheaper to use the best material obtainable, at least for the wearing surface.

The stones of the upper layer should be the wearing-surfaces of the pavements and the traffic should come in contact with them. Gravel or dirt remaining on the roadway will increase its wear and tear. Long experience in England places this beyond a doubt, and the record says: "The oftener that streets are cleansed, the less is the mud which is created and removed, whilst the attendant expenses are by no means increased, and the roads are kept in a better state of preservation. The worn particles, if left on the surface, act as a grinding powder under the wheels and the horses feet, to reduce to similar powder the surface of the road." Again—"The more frequent cleansing was instrumental not only in keeping the streets in better condition, but in reducing the wear and tear of the pavement." Therefore put no "top-dressing" on the surface layer of stones, but keep them clean and free from grinding powder.

In this specification only fine gravel and sand have been named as "binding." One or other of these is preferred to stone screenings; but cost has, of course, to be considered, and in some cases the employment of screenings will happen of necessity.

In the construction and maintenance of gravel roadways many of the suggestions included in the specification given apply with equal force. The foundation must be firm, substantial, and uniformly hard for the gravel to rest upon; and while a Telford foundation may not be necessary, it is absolutely necessary for the preservation of the pavement section to lay such a bottom course as will resist all weight of traffic coming upon it. A 6 or 8 in. layer of rubble or rough stone, laid with some care on an earth foundation, well rolled and made to conform to the required upper section of the road, will probably be sufficient for most purposes. The gravel to be placed on this foundation must be screened into three or four different sizes, and these must be then rolled layer by layer until each is compact. The top layer, of fine gravel, must be well sprinkled and rolled until it has become solid and firm. If the gravel is of such a nature as to be easily disintegrated by traffic, a small quantity of clay or hard-pan may be thrown on or amongst the upper course, and rolled in with the gravel in a dry state. It should then be well sprinkled and allowed to partially dry until the following day, and the rolling then continued with the mass of material in a damp, but not wet, state.



Steel Steam Road Roller, with Road Picking Attachment.—Aveling & Porter, Makers.

The road roller used in England for about 20 years past in constructing roads of this character is here illustrated from one of the latest type. This is the Aveling & Porter machine, already well known in this country and used in many of our cities for street work. As now made, the road roller is constructed of steel with corresponding advantages in permanence and economy in working. A 15-ton machine consumes about 250 lbs. of coal in a full day's work. It is being employed in some American cities for repairing the old macadamized streets, and the city engineer of Reading, Pa., testifies that the roads in that city can be put into first class order by the use of the steam-roller, at a cost of from 18 to 20 cts. per sq. yd., and with a profit to the contractor. This cost includes the tearing up of the old roads with the picking machine—to be described—the addition of 6 to 8 ins. of new road material and top dressing, and the engineer's service, fuel, oil, etc.

The picking apparatus, for breaking up old stone or gravel roads before recoating, is simply a pick attachment to the driving wheels, as shown in the accompanying outline cut. The advantage is apparent, for when the road surface becomes uneven it can at a slight expense be thus picked up, re-surfaced, a small quantity of broken stone added, if necessary, and then thoroughly rolled; all this at a very slight expense, and with a saving in material, as compared with common practice in road repairs, that will often more than pay the whole cost of the work. Mr. ALBERT F. NOYES, the City Engineer of West Newton, Mass., in a report upon one of these rollers, says that the steam roller with pick attachment and two men with hand picks will do the work of from 30 to 40 men with hand picks alone, according to the hardness of the bed.

We are indebted to Mr. WM. CHURCHILL OASTLER, consulting engineer on roadways, of 43 Exchange Place, New York, for much of the material here used, and we doubt not that he will answer any queries from parties interested in the machines or methods here described.

Tests of a New Steam Boiler.

A new form of steam boiler is being introduced by the Complete Combustion Co., 34 Oliver St., Boston, which has for its basis the principle of a downward draught, causing the hot gases from the fuel to be drawn downward through the body of incandescent coal upon the grate instead of passing off immediately to cooler portions of the furnace as is the case with the ordinary furnace.

The idea is by no means new, but this Company after some years of experiment have produced a design of boiler which seems to be simple and durable in all its parts, and to render superior results in economy of coal and satisfactory steaming under everyday working conditions. Its apparent merits, as demonstrated by the tests recently made, certainly seem to entitle it to be carefully considered by all users of steam power.

Results of a trial of this boiler, showing a remarkably good performance in the above respects, were given in the ENGINEERING NEWS, of March 23, 1889 (page 260), and the latest boiler built is here shown, which will obviate much description and present more intelligently the means by which these results have been reached. It is precisely similar to the boiler tested in February, differing only in size.

The tests subjoined, while not showing so exceptionally high results, are yet remarkably good, taking into account the less favorable weather conditions in July than in February, when the outside temperature was 17° Fahr., as compared with above 70° during these trials.

The tests were made at Smith & Carleton's Iron Works, South Boston, July 23 and 30, and were conducted by FRANCIS E. GALLOUPE, Mechanical Engineer, of Boston, Gen. GEO. H. REYNOLDS, of New York city, supervising the second trial, as associate engineer. A large number of those interested in matters pertaining to steam generation were present.

The boiler has an internal furnace entirely surrounded by water heating surface and was protected on the outside by asbestos covering, 1¾ in. thick. It has no brick setting, being supported on two cast iron chairs, one at either end. The course of the gases was downward through the grate and throat formed by the hanging water leg and ash pit bottom, thence upward and through the horizontal tubes to the uptake and chimney. The uptake, unfortunately, had four bends to be traversed, two of them being right angles, and the chimney, which consisted of a brick base 10 ft. high, surmounted by an iron stack 2 ft. 6 in. in diameter and 50 ft. long, was entirely inadequate to dispose of the hot gases generated, or to furnish sufficient draught to burn the coal with as low a percentage of refuse as should have been obtained. Moreover, a conical hood or bonnet, 4 ft. in diameter, was placed over the top of the stack within a few inches of the outlet and further choked the necessary draught.

Previous to the second test this hood was removed and the stack lengthened 20 ft., or so as to give an

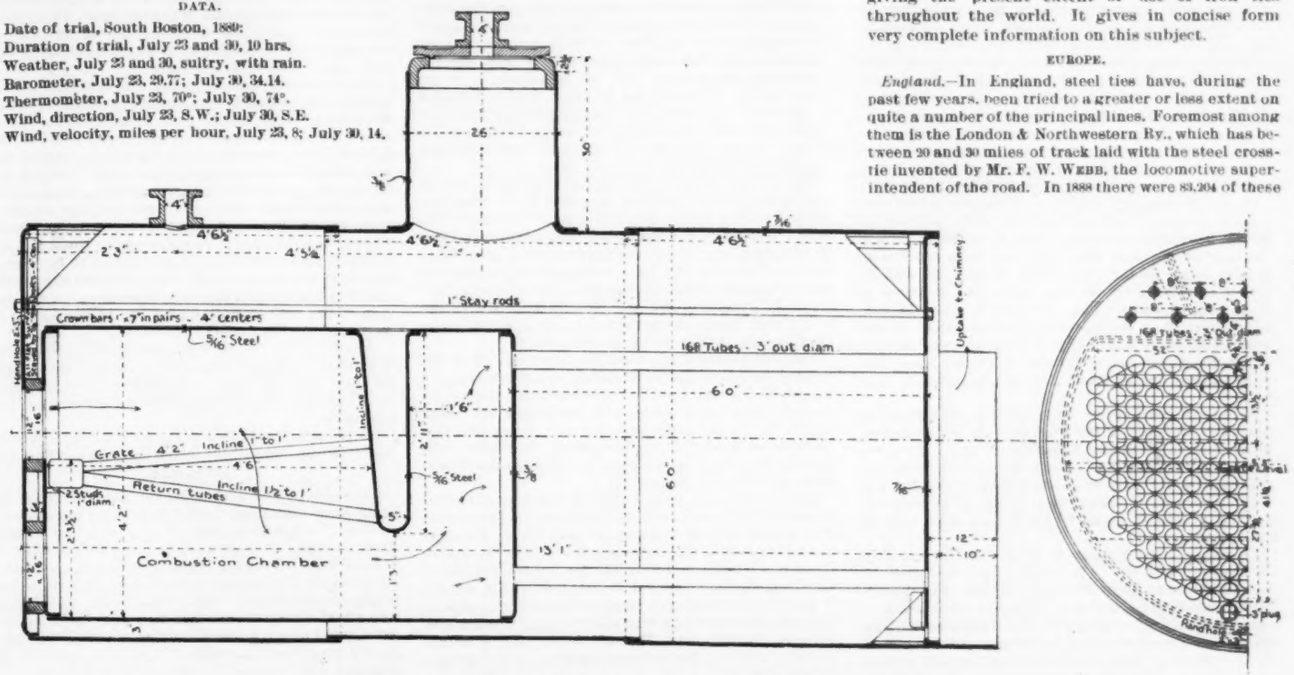
effective height of 80 ft. above the grate level in place of 60 ft. during the first, and the percentage of refuse diminished from 18.40 to 16.46, giving the increased evaporative duty to be noted in the results below.

The boiler furnished perfectly dry steam and there was no leakage. The coal used was Cumberland, from Maryland.

The temperature in the uptake varied from 350° to 500° Fahr., the averages during the trials being 385° and 398° Fahr., respectively. As the temperature of the steam and water in the boiler, at the average pressures carried, was about 321° Fahr., the loss of unabsorbed heat did not exceed 64° to 77°, which is an unusually good result.

DATA.

Date of trial, South Boston, 1889:
Duration of trial, July 23 and 30, 10 hrs.
Weather, July 23 and 30, sultry, with rain.
Barometer, July 23, 29.77; July 30, 34.14.
Thermometer, July 23, 70°; July 30, 74°.
Wind, direction, July 23, S.W.; July 30, S.E.
Wind, velocity, miles per hour, July 23, 8; July 30, 14.



Downward Draught Boiler, 75 H. P.; Complete Combustion Co.

DIMENSIONS AND PROPORTIONS.

Condition of boiler, new and clean.

Shell, diameter, 6 ft.; length, 18 ft. 11 ins. over all.

Tubes, number, 168*; diameter, 3 ins. outside; length, 6 ft.

Furnace, width, 5 ft. 4 ins.; length, 4 ft. 6 ins.

Grate, 1¼ in. tubes, extra thick, extending from water-leg to a gun metal box in front, not connected with shell; number 27; inclination, 1 in. to 1 ft.

Underneath feed pipes, 2 ins. diameter, extending from gun metal box back to water-leg; number, 8; inclination, 1½ ins. to 1 ft.

Air space through grate, spaces ⅝ ins. wide. 6.45 sq. ft. = 27.77 per cent. of grate area.

Size of grate, 5 ft. 4 ins. wide by 4 ft. 6 ins. long; area, 24 sq. ft.

Area in throat of tube chamber, 4.38 sq. ft.

Area through tubes, 8.25 sq ft.

Up-take and chimney flue, 2ft. 6 ins. diameter; area, 4.90 sq. ft.

Chimney, height above grate, July 23, 60 ft. with bonnet; July 30, 80 ft. bonnet removed.

Heating surface in grate, 78 sq ft.
" " furnace, 155 sq. ft.
" " tubes, 791 sq. ft.
" " total, 1,024 sq. ft.
" " per sq. ft. of grate area, 42.66 sq. ft.

RESULTS.

		July 23,	July 30,
Steam pressure	average,	76 lbs.	77 lbs.
Temperatures in flue	"	385°	398°
" in boiler room	"	82°	94°
" outside	"	75°	81°
" of feed water	"	158°	164°
FUEL.			
Weight of kindling wood		162 lbs.	161 lbs.
" equivalent coal (at .4)		65 "	64 "
" of coal consumed		2,673 "	2,800 "
Percentage moisture in coal		1¼ "	dry.
Weight dry coal consumed		2,640 "	2,800 "
" equivalent dry Cumberland coal consumed		2,705 "	2,864 "
" of refuse, total		486 "	461 "
Percentage of nut coal		18.40	16.46
Weight of total combustible consumed		2,219 "	2,403 "
" dry coal consumed per hour		270 "	286 "
" " " " sq. ft. grate per hour		11.25 "	11.92 "
WATER.			
Weight actually fed and evaporated		24,390 "	26,936 "
" equivalent water evaporated into dry steam from and at 212° Fah.		20,400 "	20,213 "
ECONOMIC EVAPORATION.			
Water per lb. of dry coal from actual pressure and temperature of feed		8.95 "	9.40 "
Equivalent evaporation per lb. dry coal, from and at 212° Fah.		9.76 "	10.20 "
Equivalent evaporation per lb. combustible, from and at 212° Fah.		11.97 "	12.21 "
COMMERCIAL EVAPORATION.			
Equivalent water evaporated per lb. of dry coal, with one-sixth refuse, at 70 lbs. gauge pressure, from 100° temperature		8.68 "	8.85 "
RATE OF EVAPORATION.			
Water evaporated from and 212° Fahr. per sq. ft. heating surface per hour		2.58 "	2.85 "
COMMERCIAL HORSE POWER.			
At 30 lbs. water evaporated from 100° Fahr. with steam at 70 lbs. gauge pressure, horse power developed		76.52 "	84.64 "
Horse power, builder's rating		75 "	75 "
Per cent. developed above rating		2.03 "	12 90 "

*This is for the 75 H. P. boiler illustrated. Other sizes are:

Boiler shell with 129 tubes, 60 H. P.; 142 tubes, 65 H. P.; 155 tubes, 70 H. P.; 168 tubes, 85 H. P.; 182 tubes, 80 H. P.; 196 tubes, 85 H. P.

The above performance, it is safe to say, exceeds that ordinarily realized from first-rate steam boilers of this size something over 10 per cent. It would throw much light on this matter of boiler performance, and answer the question as to what is the best boiler and what ought to be expected from it in every day working, if leading boiler manufacturers could make an arrangement by which boilers of differing forms and proportions could be set side by side and worked under the same external conditions.

By working tests extending over a sufficiently long time —say from 48 hours to a week's duration— all the points respecting boiler operation would be demonstrated in each case with an opportunity for fair comparison of one type with another, which it is needless to say, does not now exist. The information thus obtained would not only be of great use to the engineering profession, but of immediate practical value to all steam users, who would thereby obtain a standard by which to ascertain the deficiencies of their own boiler plant and how the conditions of running them should be regulated.

The matter is of growing importance for the reason that additions to existing and new power plants of vast extent will be required in the near future for the generation of electricity for its manifold purposes. We hope more information will be forthcoming in this direction.

Metal Railway Ties.

The following is the substance of a preliminary report made to the Department of Agriculture in February, 1889 by Mr. E. E. RUSSELL TRATMAN, giving the present extent of use of iron ties throughout the world. It gives in concise form very complete information on this subject.

EUROPE.

England.—In England, steel ties have, during the past few years, been tried to a greater or less extent on quite a number of the principal lines. Foremost among them is the London & Northwestern Ry., which has between 20 and 30 miles of track laid with the steel cross-tie invented by Mr. F. W. WEBB, the locomotive superintendent of the road. In 1888 there were 83,204 of these in use, and the experience with them had covered then 6½ years. These ties have been experimented with on the Pennsylvania R. R.

The general type used is the steel "inverted trough" in different forms, either rolled or stamped. As the system of track, however, includes the double-headed rail, the ties are fitted with the usual heavy cast-iron chairs to hold the rail (the Webb tie has the chairs made of steel plates), and the track is unnecessarily heavy and costly. The chief difficulty is said to be in adapting the steel tie to the double-headed rail, it being difficult to make a good piece of work. The Northeastern Ry., however, is trying steel ties under flange rails weighing 90 lbs. per yd., which is a step toward the ideal track for main lines.

France.—Experiments with metal cross-ties have been made on nearly all the principal railways, and a large number of types have been tried, but several of them have been of complicated design, and therefore uneconomical. Longitudinal systems have been tried to a small extent.

On the State Railways a number of trials have been made, and with some forms of tie very good results have been obtained, enabling a reduction to be made in the maintenance staff. In 1886 there were ordered 17,000 ties of the Post type and 80,000 ties of the old Berg-et-Marche type. In 1888 there were (*a*) 2.10 miles laid with the Paulet-Lavallette ties, with double-headed rails in chairs; (*b*) 7.35 miles laid with a tie similar to the Post type, with double-headed rails, and 30,000 more of these ties had been ordered; (*c*) 8.86 miles laid with similar ties, but with flange rails. Of these (*a*) had been laid in 1885, (*b*) and (*c*) in 1887. On the Paris and Bordeaux line, 4.4 miles of Vautherin ties of uniform thickness were laid between November, 1886, and February, 1887; 4.5 miles of Vautherin ties of varying thickness (similar to the Post type) were laid in February and March, 1887, and .56 mile was laid with the Boyenval-Ponsard ties in April, 1888.

The Paris, Lyons & Mediterranean Ry. used an old type of iron tie several years ago, but abandoned it on account of the ties costing more than the wooden ties and giving a less firm and durable track; this latter

defect was probably due to the old-fashioned gib and cotter fastening employed. These ties were laid in 1862 and following years, and had all been taken out in 1872. Good results have been obtained with metal ties on the Algerian system controlled by this company. (See "Africa.")

The Northern Ry. laid trial sections of its Belgian lines with the Severac and Bernard ties in 1885, and laid 10,000 of the former on its French lines in 1888.

The Western Ry., which used the double-headed rail, has experimented with iron ties upon which the rail chairs were cast; about 1.3 miles were laid in 1887, and 5,000 more were ordered later.

The Eastern Ry. has tried steel ties with wooden cushions or bearing blocks under the rails, and has also laid about 100 Post ties.

Holland.—In this country probably the most extensive and most valuable trials have been made, because continuous and systematic, and these trials have resulted in improvements which have served to develop the now well-known and extensively used Post steel cross-tie of varying thickness, the thickness being increased under the rail seat. This tie, the invention of Mr. Post, the engineer of permanent way of the Netherlands State Ry. Co. is economical, both in construction (owing to its requiring a minimum of shop-work, all of which adds to the cost of a tie), and in maintenance, and has proved very efficient in service.

On the Netherlands State Rys., the experiments have been in progress since 1865, and the steel tie designed by Mr. Post and improved by him from time to time in the light of practical experience has been adopted on this system. In the early part of 1888 the system, which comprises 910 miles of road, had 91 miles of track laid with these ties. Of 10,000 ties laid in 1865, 9,550 were still in the track, and were expected to last 20 years more, although they were of the earlier type of the tie, which has since been improved upon. As to breakages, out of 162,634 ties laid, not one had broken.

In the early part of 1888 there were in use 457,300 ties (about 23,800 tons) of the Post type in Holland, Belgium, France, Germany, Switzerland, and Asia (colonies); about 272,700 ties (about 12,700 tons) more, including ties for narrow-gauge railways and for the rack railway in Sumatra, were being manufactured; making a total of about 730,000 ties, or 36,500 tons of this one type.

Belgium.—On the Belgian State Ry. system the Post tie has been laid, but it is heavier than that used on the Netherlands State Ry., and heavier than the inventor considers necessary or desirable. (It should be noted that it is not economical to use more metal than experience has shown to be necessary; but in most of the new forms of ties the thickness and weight are reduced below a reasonable minimum.) Experiments have been made on rather a large scale, and in 1887 three types were experimented with on various lines, and one of these types appeared to meet the requirements for fast and heavy traffic. In 1885 it was decided to put down 35,000 ties of the Post (old) type, 35,000 ties of a type invented by the chief engineer of the road, and 5,000 ties of the Bernard type. Some Bernard ties were also laid in 1886-87.

The Grand Central Ry. has also had satisfactory results with metal ties. In 1873 the superintendent of permanent way reported that he was fully satisfied with the experience then acquired with metal ties, but he was unable to adopt them further at that time owing to a great advance in the price of iron. In his reports for 1886 and 1887 he stated that the favorable results had been still more marked, and during 1887 there were 6,000 metal ties laid.

Metal ties of the Coblyn type, for light railways, have been definitely adopted by the Société Anonyme des Chemins de Fer Economiques, and have also been tried on the lines of the Société Nationale des Chemins de Fer Vicinaux, the Netherland lines, the Liegeois and Luxembourg division (on Belgian territory) of the Netherlands State Ry. and on the Liege and Seraing line. Metal ties have been tried on the Belgian division of the Northern Ry. of France, including 5,500 ties of the Bernard type.

Germany.—On the State Rys. a number of different systems of metal track of longitudinal and transverse types have been tried for several years, and some types have been regularly adopted on certain divisions. The investigations and trials are still in progress. In 1887 the State Ry. system had a length of about 13,193 miles, with about 23,662 miles of track; of this amount about 5,530 miles had metal track—3,131 miles being laid with cross-ties and 2,399 miles with longitudinals. Very careful records of the trials have been kept. In the year 1886-87 there were laid 868,262 new cross-ties and 64,094 longitudinals. In February, 1888, 500,000 Post ties were being made for German lines.

For the Rhenish Ry. system 309,800 ties (10,775 tons) were purchased in 1877-79. On the Left-Bank-of-the-Rhine Ry., which comprises 1,681 miles, there are 943 miles with metal cross-ties and 211 miles with longitudinals, the balance being on wooden cross-ties. The first cross-ties were laid in 1876 and the first longitudinals in 1872. Since 1879 metal ties only have been used. On the Elberfeld division of the Prussian State Rys., (1,646 miles) there are 790.5 miles laid with wooden ties, 762.5 with iron ties, and 93 miles with iron longitudinals. They were laid in different years between 1869 and 1880.

The experience with iron longitudinals and cross-ties was very favorable, but still better results have been obtained since steel was introduced. Wooden ties are still used in great numbers, partly on account of their lower first cost, and partly on account of the policy of the Prussian Government to keep up the supply of timber by domestic cultivation and forest management.

Austria.—In this country, longitudinal systems of metal track have been extensively used. The Northwestern Ry. has a total of 59¼ miles of track laid with the Hohenegger system of longitudinals, and the economy over wood is reported to be noticeable. These longitudinals have been laid in small sections, year by year since 1876; the earlier ones were of iron, but the latter ones are of steel. The Heindl system is in use on a number of roads; the first were laid in 1883, and at the end of 1887 there was an aggregate of about 141 miles laid with this system of track, a considerable portion being on mountain divisions and including 6.634 miles on the Arlberg tunnel line.

Switzerland.—The Central Ry. had 100,000 metal ties in use at the end of 1884, and proposed to lay 30,000 per annum till its whole system had been thus laid. The Western and Simplon railways began using metal ties in 1883, and have been very well satisfied with them. The Gotthard Ry. uses them very extensively, and they have also been adopted on the Mount Pilatus rack-railway. In February, 1888, the Hoerde Steel Works reported that they were delivering 160,000 Post ties to the Gotthard Ry. and 160,000 to the Western Ry.

Italy.—Metal track has been used very little, if at all, oak ties being obtainable in ample quantities and at a moderate price; and as there are extensive timber resources, such track will not be necessary for many years. It has been proposed, however, to lay steel ties on some sections of the Mediterranean Ry. system. The Government has used steel ties for short military railways in its African campaigns.

Spain.—The line from Bilbao to Las Arenas has 7.3 miles laid with steel cross-ties, and it is believed that they will prove more economical than wood. The line is 1-metre gauge. The Almanza, Valencia & Tarragona line has 251 miles laid with the De Bergue system of cast iron plates connected by tie-rods. This system is found to give greater economy, and the gauge is maintained better than with wooden ties. The division between Valencia and Tarragona was laid with this track in 1860, and the division between Almanza and Valencia in 1873.

Sweden.—On the State Rys. about two-thirds of a mile were laid with metal ties, for experimental purposes, in June, 1886. This is the only case where they have been used in Sweden or Norway.

Denmark.—On the State Rys steel cross-ties were laid for about 18 miles in 1883-84; but the results, as reported in 1888, have not been entirely satisfactory, owing to the insufficient weight and strength of the ties.

Russia.—Metal ties have only been used to a very limited extent, on two branch lines, and even there they have not been sufficiently used to enable any reliable conclusions to be drawn from the experiments. (The metal ties laid on the Moscow Kursk Ry. were removed because their maintenance was found more expensive than that of wooden ties. It is claimed that at present prices for wood and for metal in Russia, the metal ties, weighing 105.8 pounds, with an estimated duration of thirty-five years, were two and a half times as expensive as the pine ties impregnated with chloride of zinc, lasting ten years, and one and one-half as expensive as oak impregnated and lasting six years. Conditions in Russia, however, are exceptional as regards labor and material.—B. E. F.)

AFRICA.

Cape Colony.—The Cape Government Rys. have some sections of the lines laid with cast-iron bowls; they are arranged in pairs and connected by transverse tie-rods. The Delagoa Bay Ry, one of the new lines opening up the interior, is laid principally with steel ties.

Senegal.—About 5,000 ties of the Severac type have been ordered for the railways in this French colony. Cast-iron bowls are used on the French island of Réunion.

Egypt.—On the Egyptian Agricultural Rys., wrought-iron plates connected by tie rods have been used and also cast-iron pots or bowls. In the English campaign of 1885 a short length of light railway of 18-in. gauge, with corrugated steel cross-ties, was laid at Suakim, but the line was soon taken up.

Algeria.—Metal ties are used on the Algerian lines controlled by the Paris, Lyons & Mediterranean Ry. Co. (France); 10,000 ties were laid in 1870, and have given good results. In 1867-69 the Algiers and Oran line put down 90,000 iron ties of the Vautherin type; the Bône and Guelma line put down 3,500 ties of the Severac type and 2,500 of the Boyenval-Ponsard type. It is estimated that the use of metal ties has saved one-fourth of the labor formerly required for maintenance, or about $60 per mile per annum.

ASIA.

India.—In this country, steel cross-ties and cast-iron bowls and plates (the latter types arranged in pairs) are very extensively used, and the use of metal track is extending very rapidly, large contracts being frequently awarded for the companies' and the Government lines. Even in Burmah, where wood has been generally used till recently, steel ties are beginning to be introduced.

About 525,000 tons of steel ties have been sent out from England during the last few years, and there are nearly 300 miles of the State lines now laid with this form of track; a large number of miles of private companies' lines are also laid with steel ties. The general results are reported to be good, and the ties give, on the whole, much satisfaction. They are used for lines of 1 metre and 5 ft. 6 in. gauge.

There are over 1,600 miles laid with cast-iron track of different types, and these also give satisfactory results in general. Such tracks have been in use for 12 or 14 years. Of the Denham-Olpherts type alone more than 2,000,000 pairs have been made for double headed rails and about 600,000 pairs for flange rails. On the East Indian Ry. there were 1,311,000 of these Denham-Olpherts plate ties at the end of 1887, and the breakages since 1885 had averaged only 0.84 per cent. per annum. They give good results in reducing the work of maintenance, there being a saving of about 6½ per cent. of renewals per annum. In some of these ties wooden cushions are used for the rails to rest on. On one division of the Indian Midland Ry. the percentage of renewals of the Denham-Olpherts plates was 0.31.

Japan.—A few cast-iron pot ties were laid when the first lines were built, about 1871, but they have nearly all been taken up again and hardly any now remain in the track, while for new lines timber ties are used exclusively.

China.—Steel cross-ties are to be tried as an experiment on the new railway which was opened last year.

AUSTRALIA.

Queensland.—The first metal ties ever made in Australia have been tried in this colony, an experimental section of a few miles long having been laid with the Phillips type. This is a steel cross-tie intended for prairie work, where the track is laid on the surface of the ground; it is designed to be used without ballast, being simply packed with surface soil. Some years ago about 1,000 wrought-iron ties were laid, but they only lasted about 5 years, as they generally fractured under the rail-seats, owing, it is said, to defective fastenings; they were laid in broken-stone ballast.

In regard to the Phillips type, Mr. PHILLIPS kindly reports to me as follows, under date of Jan. 2, 1889, and it is especially interesting as showing that metal track is adapted for other lines than those with heavy traffic:

I have just returned from North Queensland, where I have been constructing a section of railway 36 miles in length on my system. The country I am dealing with is between the port of Normanton, in 17° 45' S. lat. and 141° 10' E. long., and a new goldfield by the name of Croyden, situated about 85 miles E. S. E. from Normanton. The country is almost uniformly even and the Norman river is the only important river crossed. The first 4 miles are over gravel ridges, when a descent of 1 in 70 for half a mile brings the line down to the level of the river flats; the soil is dark clay with a slight admixture of alluvial sand. This description of country extends to 14 miles, where the river is crossed with a low level timber bridge (principally 20-ft. spans) on a sandstone rock bottom. Thence to Croyden the country is very uniform in character—fine sandy soil, covered with a more or less thick forest of inferior and stunted timber, sometimes dense enough to be called brush or shrub. There is no forest timber of sufficient dimensions in the district available for ties or bridge work, neither is there any stone for ballast except by quarrying below the surface, and that is sandstone of an inferior and very soft description. The country is almost uniformly even, except at the 4-mile peg, where there is a cutting of about 5 ft. and an embankment of equal height. I commenced track-laying July 7, and completed 32 miles on Dec. 29; fully 7 weeks were lost through non-delivery of ties, so that the average rate of progress was 1¾ miles per week of 6 working days. The number of men employed in (*a*) clearing track 66 ft. wide, (*b*) grubbing, (*c*) ploughing harrowing, and rolling central width of 10 ft., (*d*) track-laying, (*e*) lifting and packing ties, and (*f*) straightening track never exceeded 65, with one team of bullocks (12) and one horse. Cost per mile for labor only, $630; wages (for laborers, $2.50 per day; gangers, $3.15. The ploughing, harrowing, and rolling cost $75 per mile, and is included in the $630. The total cost was under $15 per lin. ft. The best day's work was 0.525 miles and the best week's work a little over 2 miles. No ballast has been provided and no side or cross drains cut;

the only water-ways are at well-defined and water-worn-channels. The total timber bridging on the 36 miles is 1,108 lin. ft. and only one box-drain has been put in. From 20½ miles to 36 miles there is not a single water-way of any description. The cost is under $15 per lin. ft.

The material train has never failed to run to the head of the road daily, from the commencement of track-laying, although there have been some very heavy thunder-storms with 1 to 2 ins. of rain-fall in an hour. The track is laid with steel flange rails, 41½ lbs. per yd., 26 ft. long, fastened to mild steel cross-ties, weighing 84 lbs. each; 11 ties to a rail length. The average gross load of the material train was 100 tons. The locomotive employed is a 6 wheeled engine of English build. The country passed through is believed to be the softest in wet weather to be found in Australia, but so far no trouble has been experienced with the line. The country is infested with white ants (termites), and ties of the best hard woods of the colony will not last more than 3 years. The government now in power is not very favorable to my system, but I hope to be able to induce them to complete the Croyden Ry. with it. I believe my system might be applied with advantage to your prairie country subject to heavy rain-falls.

New South Wales.—About 1,000 steel cross-ties were laid in 1882. In 1887 it was reported that they were in bad condition, but this may have been due (if correct) to the fact that the manufacture of steel ties was in its infancy in 1882.

South Australia.—In March, 1888, the agent-general in England reported to me that metal cross-ties were being laid on a new line 145 miles long, not then open to traffic. This line is in the extreme north of the colony.

SOUTH AMERICA.

Argentine Republic.—In this State, cast-iron pot ties are used almost exclusively, except in the far west and north. The Buenos Ayres Great Southern Ry., which began operations in 1865, has 13¾ miles of double track and 819½ miles of single track laid with cast-iron ties o an improved design. They are adopted on account of the difficulty of procuring good hard-wood ties in sufficient quantity and the greater expense of these wooden ties; also because they give a more rigid and satisfactory track. The Central Argentine Ry. has 246 miles laid with cast-iron track. The Santa Fé & Cordoba Ry. ordered 20,000 steel ties in England in 1888.

Chili.—Steel ties have been tried to a small extent, but the type was considered too heavy and expensive. Previous to the award in November last, to an American syndicate, of the contract for building about 780 miles of railway for the State, proposals had been invited by the Chilian legation in France for the supply of 739,400 metal ties 9 ft. long and 725,100 ties 4½ ft. long.

United States of Colombia.—There has been some talk of adopting metal ties on the Bolivar Ry.

MEXICO.

The Mexican Ry. (Vera Cruz line) is using a large number of steel ties of the type in general use in India and has obtained very good results with them, especially at times when the road has been flooded. These ties were first used in 1884, and at theend of June, 1888, there were 46½ miles of track laid with steel ties. The Mexican Central Ry. has been contemplating the adoption of the same type of tie on the mountain division of the road, the advantages being that they last longer than wooden ties and keep the track in perfect gauge.

The Bleichert Cable Transport System.

A new aerial transportation system has been introduced into this country by ex-Mayor HEWITT'S firm of iron founders, and one of the earlier plants is in operation at the limestone quarries of the Solvay Process Co., at Geddes, N. Y., while another is in process of erection at Aspen, Col. The system, which is known as the BLEICHERT system of aerial tramways, is of German invention, and some important lines are said to be in operation in Europe. It consists of a fixed cable supported by suitable uprights in which run carriages, from each of which depends a bucket, while a secondary cable supplies the power. The line at Geddes is about 17,000 ft. long, and surmounts a grade of over 300 ft. The two cables are of steel wire, and are 34,000 ft. long in the circuit. The supporting cable is of two sizes; one side being 1⅝ ins. in diameter, the other 1 in. in diameter. On the larger one the buckets coming from the quarry with the limestone are supported and are returned on the smaller division. The other, the transmission or traction cable, is ⅝-in. diameter, propelled and controlled by a 30 H. P. engine, and to this the buckets are attached by a grip, and so transported to and from the quarry. Gravity favors the line considerably, so that the average power required does not exceed 15 H. P. Expansion and contraction of the cables is compensated by means of heavy weights. The transmission or traction cable, the one which pulls the buckets along, runs on large grooved wheels, which are placed horizontally at each end of the line, and a proper tension is secured by a system of sliding pulleys, attached to weights. There are 4 tension stations and 105 supporting stations. The latter are about 150 ft. apart, and vary in height according to the elevations and depressions of the ground along the route. The highest supports are 49 ft. high, and the lowest are 8 ft. high. The spans also vary, the longest being 300 ft. There are 200 buckets, each one capable of carrying 1,000 lbs. of limestone, 770 lbs. being the present average amount brought to the lime kilns by each bucket. The cable is run day and night, and about 400 tons of the stone are delivered during the 24 hours. As the buckets approach the kilns, the grip which holds them to the traction cable is automatically set free, and the buckets glide on to a permanent way, which forms a series of loops over the kilns.

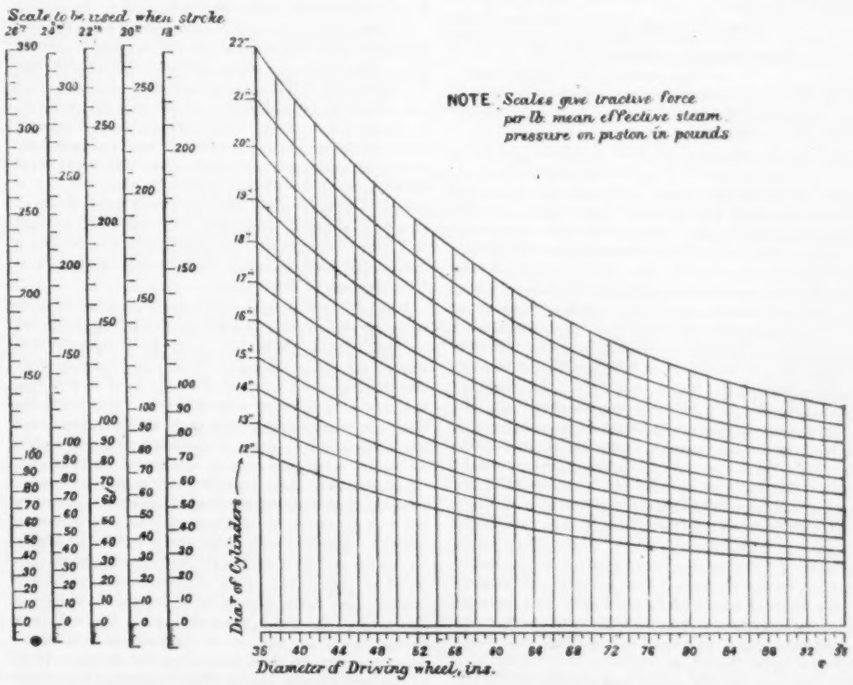

Scale to be used when stroke
26" 24" 22" 20" 18"
NOTE. Scales give tractive force per lb. mean effective steam pressure on piston in pounds
Dia. of Cylinders
Diameter of Driving wheel, ins.

Diagram for Determining Cylinder Tractive Power of Locomotives.

Tractive Power of Locomotives.

A correspondent, G. R. B. of *The Engineer*, sends to that paper the accompanying convenient diagram, which he explains in substance as follows:

The diagram gives in pounds the tractive power of locomotives per pound of mean effective steam pressure on piston, and is one which will be found very useful in solving all questions relating to size of cylinder for given tractive power, length of stroke, maximum diameter of driving wheels, etc., and also for facilitating the comparison of the tractive power of different engines.

As an example of the use of the diagram, suppose we require to know what will be the mean tractive power of an engine having cylinders 17 ins. diameter by 22-in. stroke, and driving wheels 60 ins. diameter. At the point marked 60 ins. on the scale of diameters of driving wheels at the bottom of the diagram, with a pair of dividers measure the length of the ordinate from the base line up to the line marked 17-in. diameter, transfer this to the scale to be used when length of stroke equals 22 in., and read off 106 lbs. as the tractive force which will be exerted for every pound mean effective preasure on the piston, or

$$\frac{17^2 \times 22}{60} = 106.$$

Again, given the diameter of driving wheels, length of stroke and tractive power, required the diameters of cylinders. Reduce the traction to pounds per pound of mean pressure, and taking this value on the scale to be used for the given length of stroke, set it off over the given diameter of wheels, and read off the diameter of cylinders required. Other uses of the diagram will readily suggest themselves to locomotive engineers.

The Sprague Motor Cars on Fourth Avenue, New York.

Mr. WILLIAM BRACKEN read a paper at the Niagara Falls meeting of the National Electric Light Association, upon "Storage Battery Traction," in which he said:

From my observation of our recent work on Fourth and Madison Aves. now that we are running a number of cars, and under very unfavorable conditions as to station room and the like, I am led to believe that the storage battery car is as free, if not freer, from accident than cars that are run by the overhead system. The motors are, I think, subjected to less trying conditions, owing to the fact that the E. M. F. is always uniform. The batteries never give out on a trip. It is impossible for them to do so, as they leave the station with 35 electrical H. P. hours stored in them, and do not consume quite 12, in the round trip of 12 miles. We have never short-circuited the battery in the service. When the current required exceeds 150 amperes, the battery is automatically cut out. When we used rigid connectors, we frequently had difficulty with their breaking, and the flexible connector, has, until recently, given us some trouble, from time to time, by jumping out of position, while the car is in service; but with our recent improvements in disconnection of the batteries, while the car is in service, this is now rendered almost impossible. For several months past, we have had absolutely no trouble from our regulators. In any event, there are two on the car, so that if one should fail, the car may be operated from the other end. You will thus perceive that the likelihood of accidents or breakdowns is reduced to a minimum. Our first standard car has run in three months over 6,000 miles and carried over 80,000 passengers, never having missed but one-half a trip in that time; and that arose from a bent axle. It has never had an accident or stoppage of any kind while in service. Do not be skeptical at the assertion, when I tell you that we have never spent a dollar on that car in the way of repairs or alterations.

At this stage, you will naturally ask, How about the life of the battery? I answer that from our observations, we have nothing to fear on that score. We only ask a life of six months from the positive plates; we know that they will last very much longer than that. The chief reasons why the short-livedness of a storage battery has been so much talked about and feared is that it has, until recently, cost so much to manufacture the battery. Now the material for your battery

you have to buy, in a great measure, but once, for the reason that the discarded battery can be made over new. The raw material in two sets of battery, capable of running a car 120 miles a day, costs, exclusive of the containing jars, about $900. Have you machinery and devices requisite for manufacturing this raw material cheaply into a battery? If you have, you need have nothing to fear on the score of economy. It will cost $4,000 to purchase enough horses to run a 16 ft. car 120 miles a day; it will cost about $1500 to purchase enough battery to do that work. The batteries can be maintained for about one-half what it costs to maintain the horses; and by maintaining I mean replacement as well as feed. This I know for a fact. Can we then have any further doubt as to relative economy of storage battery traction?

The cars on the Fourth and Madison avenue line take one electrical horse-power hour per mile. The cost of motive power for a car-day of 75 miles we estimate at $3.40, as against $7.50 for horses; $5 for 75 miles ought to cover the cost in winter. A set of batteries is easily charged in about two-thirds of the time the other is in service.

The Sault Ste. Marie Canal.

The magnitude of our interior commerce is but little appreciated. Compared with it our foreign commerce is a bagatelle. As early as 1850 the commerce passing through the Erie canal was found to exceed in tonnage and value the whole foreign commerce of the United States. In fact, the tonnage of vessels entering the port of New York in 1887 (American and foreign) varies but little even now from the commerce passing through the St. Mary's falls canal at the Sault. The daily registered tonnage through the Sault for 1886 was 18,937 tons, while that through Suez in the same year was 15,802 tons. The lake vessels average one-half the tonnage of those passing through Suez, the number through the Suez in 1886 having been 3,096, while the number passing through the Sault was 7,118. The number through the Sault in 1887 was increased to 8,823. In the 212 days of navigation in 1888 there passed through the Sault canal an aggregate tonnage of over 6,200,000. This, for seven months of navigation, would average 900,000 per month, or nearly double the monthly tonnage of the Suez canal for the same year. An equally noteworthy fact is the steady increase in the size of lake vessels. Thus, while there was a decrease of 1,552 vessels, there was an increase of 37 per cent. in the registered tonnage, and an increase in the average cargo of 40 per cent. The average cargo of registered vessels in 1887 was 644 tons, and in 1888 876.6 tons. The total valuation of commerce in 1888 was $82,156,020, an increase of $3,000,000 over 1887; and this is the more remarkable when the short wheat crop and the increasing rail competition are considered.

A New Wrinkle in Irrigation.

The altitude of the treeless plains of Kansas varies from 2,000 to 4,000 ft., the slope being so gradual and uniform, and the surface in general so smooth, that the fact that the plains constitute one vast hillside is not apparent without the use of the level. The soil of the Arkansas River valley is, according to the natives, a rich, sandy loam, with an average depth of 4 ft., while that of the upland is from 30 to 60 ft. in depth. It is claimed that these plains once formed part of the bed of the sea. They have an average fall to the south of east of 7½ ft. per mile. Across them flows the Arkansas river on its way to the lower Mississippi. Its banks are quite regular, and have an average height of but 4 ft. above the river bed, which is composed of fine sand. One might naturally suppose the river to be subject to frequent overflows, but such is not the case. Sometimes an exceedingly heavy rain over a wide area turns in water enough to cause a local freshet, but a general overflow is, from the very nature of things, impossible. The river's sources are far away in the mountains, its tributaries are few and far between, and they are supported in the same way as the main stream—by slowly melting snows. Shifting sands underlie, not only the rivers, but the land to a very wide extent, and the soil is porous and absorbent, so that any sudden rush of water at any point quickly spreads out. It is believed in the Southwest that this combination of circumstances places within easy reach the most complete, the cheapest, and the most reliable system of irrigation the world ever saw; and the possibility is about to be tested on a large scale.

The comparatively uniformity of surface in southwest Kansas makes the cost of constructing irrigating canals probably less than in any other region where irrigation is practiced, and makes nearly the entire surface of the country accessible to ditches. There are portions where one might draw a plow furrow for 50 miles in a straight line without lifting the plow from the ground or striking a square foot of useless land, and then cross it at right angles with a similar furrow. The uniform fall to the eastward of 7½ ft. per mile makes it possible to cut a ditch from the river, and by giving it a fall of, say, 2 ft. per mile, to speedily carry the water out upon the higher lands on either side, which gradually rise to an average height of about 30 ft. above the river. No expensive blasting or costly stone dams are required, and only a very small amount of fluming generally, though "draws" or ravines sometimes have to be crossed near the river.

But the strangest fact in connection with the Arkansas is this—but a small part of the water coming down the river runs above ground. The sandy bed of the stream is but an exposed strip of a wide and deep bed of sand and gravel underlying the country, reaching out for many miles on each side. Through this vast filter there slowly percolates a grand body of water compared with which the Arkansas river above ground is but a rivulet in size. It is, of course, impossible to give the exact proportion of this vast, sluggish underground stream, but enough is known to warrant the belief that herein lies a most important factor in the solution of the irrigation problem of the plains.

Practically the same conditions are said to exist with the Platte river as with the Arkansas, and there is little doubt that they exist to a considerable extent on other streams. It is not probable that the underground current of water is of a uniform volume, as is the case with the river. It is probable that the variations of bed rock and surroundings are such that it is more in the form of great bowls or basins, with narrower or shallower connections. To utilize this great known water supply no costly, tedious, and hope-destroying delays are necessary for the purpose of making preliminary surveys. The thousands of wells put down by the railways, by towns, and by individuals throughout the Southwest are equivalent to a thorough survey already made. The main fact is that, even when the river bed is dry, the water beneath always lies within a few inches of the surface of the sand, and is, therefore, never more than 5 ft. below the average level of the first bottom lands. The irrigating canals, as at present constructed, are cut down to a depth of 4 ft., and opened into the river. It is now proposed not to open them into the river at all, but simply to extend them up the valley, gradually deepening as they advance, with the idea that they will soon tap the underground stream, and without the expense of dams or headgates have a constant supply of water.

A large basin is then to be excavated at the head of each irrigating canal relying upon this underground supply. There may be difficulties to overcome in putting such a method of obtaining water into successful operation, but it is confidently believed that they can be overcome.

Dr. A. T. SOULE, the Rochester millionaire, proposes to utilize these facts, or rather to test these possibilities, by building two new irrigating ditches, one on the south side of the Arkansas, near Dodge City, to be 25 miles long, and the other on the north side, to be 50 miles long. Both of the ditches which he is now about to build are to have their sources, so to speak, in reservoirs half a mile long, 40 or more feet wide, and excavated to a depth of at least 10 ft. below the river bed. These reservoirs will be located near the stream, but on opposite sides of it. Mr. SOULE is said not to be in love with dams, for he had to build several across the Arkansas before the present successful one was secured, and the series represented several hundred thousand dollars. His present experiment will be carefully watched by all who are interested in the arid belt, for if it prove successful the speedy reclamation of great areas would seem to be but a question of two or three years, particularly if the Government should lend a helping hand.

Dr. SOULE is by no means a novice in irrigation works, but has used his millions to great public advantage. His great work is a ditch in Ford and Edwards counties, which is 96 miles long and 45 ft. wide, and which carries 5 ft. of water. It has 250 miles of laterals, some of which extend 15 to 20 miles from the main ditch. This monster artificial channel, which is a third as long and fully as wide as DEWITT CLINTON'S original "ditch," was only completed last fall, five years and $500,000 having been spent in constructing it and damming the elusive Arkansas river, its source of supply. It was almost at once sold to an English syndicate, which paid $1,000,000 for the canal and its appurtenances, and proposes to make productive the vast area tributary to it. Having unloaded one ditch at such a handsome profit, Dr SOULE was naturally encouraged to construct others.

The German Railways.

The total length of the German railway lines on April 1, 1888, amounted to 39,157 kilo. (1 kilo.=.621 mile), of which 27,921 kilos. or 71.3 per cent. were single lines; 11,174 kilos. or 28.5 per cent., double lines, and 62 kilos. treble lines. The various State systems (Prussian, Bavarian, Saxon, Wurtemburg, etc.) figured in the total length for 34,394 kilos.; railways worked by private companies only represent a length of 4,763 kilos. In the course of the year 1887-88 the repurchased railways—from Berlin to Dresden, Nordhausen to Erfurt and Aix-la-Chapelle—were incorporated in the Prussian system, of which the length amounted to 22,690 kilos., or 944 kilos. more than in the year 1886-87. By this it will be seen that nearly 90 per cent. of the railway system of the German empire is owned by the Government. The net revenue to the Government from this source is over $125,000,000 annually.

PERSONAL.

Mr. F. WATTS, formerly President of the Cumberland Valley R. R., died Aug. 17 at Carlisle, Pa.

Mr. E. T. SMITH has been appointed Purchasing Agent and Assistant to the General Manager of the St. Louis & San Francisco.

Mr. C. A. DOLPH, who has been the General Attorney for the Oregon Railway & Navigation Co., for the last 6 years, has resigned.

Mr. J. BRADT, for 30 years Master Mechanic on the Erie road, has resigned, and has been succeeded by Mr. J. E. SAGUE, of the Erie shops at Jersey City.

Mr. OTTO MILLER has been appointed Superintendent of the Galena Division of the Chicago & Northwestern, vice Mr. CHAS. MURRAY, deceased.

Mr. ALPHEUS P. KENYON, of Allegany, N. Y., is the candidate on the Prohibition ticket for the position of State Engineer and Surveyor of New York.

Col. R. C. BARKLEY, of Charleston, S. C., has resigned his position as President of the Eutawville Railroad. He is interested in the projected Walterboro & Yemassee road.

Mr. CHASE ANDREWS has resigned his position as President of the Zanesville & Ohio R. R., and Mr. C. M. WICKER, formerly Vice-President of the Fort Worth & Rio Grande R. R., has been elected to succeed him.

Mr. WM. B. STRONG, President of the Atchison, Topeka & Santa Fé R. R., has resigned his position, after having been connected with the road for a number of years.

Mr. ROBERT BELL has been appointed General Superintendent of the Western New York & Pennsylvania, vice Mr. GATCHELL resigned. He was formerly Superintendent of the Pittsburg division, and before that was connected with the Baltimore & Ohio.

Mr. JOHN W. HILL, C. E., of Cincinnati, O., has been appointed the engineer for the construction of the new water-works at Seattle, Wash., and will formally take the work in hand as soon as negotiations, now in progress for the arrangement of some details of the engagement, are adjusted.

Mr. ALEXANDER MANVEL, First Vice-President of the St. Paul, Minneapolis & Manitoba, will succeed Mr. WM. B. STRONG as President of the Atchison, Topeka & Santa Fé. He was connected with the Rock Island road from 1859 to 1881, when he resigned to accept the position of General Superintendent of the St. Paul, Minneapolis & Manitoba Railroad. Six months later he became the General Manager, and less than a year ago he was elected First Vice-President of that corporation.

Mr. H. D. BUSH has just retired from the Superintendency of the works of the Dominion Bridge Co., at Lachine, P. Q. On Saturday evening, Aug. 31, a supper was given to the retiring officer in the template room at the Lachine works, which had been appropriately decorated for the occasion. About 160 officers and employés were present, and speeches were made by Messrs. IRA ABBOTT, Asst. to the President; PHELPS JOHNSON, Chief Engineer; Mr. BEADIE, yard foreman, and others. The latter spoke of Mr. BUSH's success in re-organizing the shop when he took charge of them, turning out the Sault St. Marie, Fredericton, and other large bridges with a rapidity that surprised even the men who worked on them. Letters of regret were read from President JOB ABBOTT and several members of the Board of Directors. During the evening an elegant gold watch was presented to Mr. BUSH.

BOOK REVIEWS.

Census of Massachusetts, 1885. Vol II. Manufactures, the Fisheries and Commerce, CARROLL D. WRIGHT (HORACE G. WADLIN successor) Chief of Bureau of Statistics of Labor, Boston, Mass. 8 vo. pp. 1,543 and cexxxix.

This volume is a remarkably elaborate and complete presentation of the statistical facts covered, boiled down in the introduction of 239 pages. A few facts noted almost at random from its pages are the following

Average number of partners to a private firm has decreased from 1.51 in 1875 to 1.36 in 1885; average number of stockholders in manufacturing corporations from 50 to 45.

	Millions of Dollars. Capital in mfg.	Product, goods made,	do. per $1 capital.
1865	93.4	272.0	$2.91
1870	201.6	482.1	2.39
1875	252.4	528.9	2.10
1880	303.8	631.1	2.08
1885	407.6	674.6	1.66

The steady decrease in the last column is notable, as indicating on how much closer margin business is done now than it used to be.

The falling off in rates of increase of Massachusetts manufacturing, in the face of enormous increase in the country as a whole, is also notable.

The main increase in manufacturing is now confined to the coast counties; 144 towns out of 348 show an actual decrease (of 29.8 per cent.) since 1875 in manufacturing output, against 204 towns showing an increase of 38.8 per cent. The average for the State is 27.6 per cent. of increase in the decade, but in the last half decade the increase is only 6.9 per cent. It is to be remembered that these figures are now nearly five years old.

Since 1875 there has been a decided decrease in the number of children employed, practically none being under 14, and only 17.1 per cent. under 20. The percentage of males is about 66.5, and slightly increasing; 38.7 per cent. as against 33.6 per cent. work at piece work. The number of women furnished with work at home shows the remarkable falling off of 18,333 against 30,916 in 1875.

Out of 248,200 weekly wage earners, only 4 per cent. of the men and 0.36 per cent. of the women get $20 or over; getting $15 to under $20 there are 15.5 per cent. of men and 0.66 per cent. of women. Half (47.4 per cent.) of the men, and practically all (94 per cent.) of the women get under $10; 56 per cent. of the women earn under $5.

The longest working hours are, in about 76 per cent. of the establishments, 10 hours, and in 18 per cent. over 10 hours, the remainder being less than 10, mostly 9 hours. 307 working days is the prevailing yearly average, or about 94 per cent. of the total possible.

Steam engines increased from 2,525 to 4,317 (all comparisons, unless otherwise stated, are between 1875 and 1885), or 71 per cent. Water wheels fell off from 2,950 to 2,576. The horse-power used is 365,517, of which 65.3 per cent. is steam, 34.6 water, and only 0.14 per cent. electric, caloric, gas, oil and windmill together. About 81 per cent. of the total capacity of motors is used. The water H. P. has increased 14.25 per cent. against 118.35 per cent for steam. Only 270 horses against 254 in 1875 are used for power.

There are in all 23,431 manufacturing concerns of which 949 are corporations, 309 of which are "close," i. e. have less than 10 stockholders, 84 having only two or three. The capital invested in the various manufactures stands as follows, in millions of dollars

	1875	1885	*Inc.*	p. c.
Boots and shoes	16.7	34.3	17.6	105.6
Building	1.3	11.3	10.0	51.2
Clothing	8.2	12.4	4.2	108.2
Cotton goods	57.0	118.9	61.9	108.7
Food prep'ns	5.8	20.8	12.0	130.9
Furniture	4.4	9.3	4.9	110.7
Leather	7.5	12.3	4.8	63.4
Machinery	12.4	24.7	12.4	100.0
Metals and metal goods	19.6	33.2	13.6	69.7
Paper	9.7	22.0	12.3	126.7
Printing, books, etc	5.7	10.6	4.8	84.3
Print works, dyes and bleaching	2.3	16.2	13.9	605.6
Rubber and m'f'rs	3.1	10.9	7.8	250.1
Woolen	15.4	30.0	14.6	95.2
Worsted	1.5	10.7	9.2	606.3
Other	78.8	122.0	44.2	56.0
All [industries]	252.4	500.6	248.2	98.3

In value of goods made, the truer test, the large increases are in the boot and shoe, building industries, and food preparations, aggregating 107 out of 146 millions of increase. Metal, paper and machinery output has increased very moderately.

Of accidents to persons there were 33 deaths and 64 permanently disabled, all males but one, in a total of 379,328 employés. The number of copies of newspapers and periodicals published per annum has increased from 142 to 204 millions, or 44.07 per cent.

Fishing products are falling off, and are only $6,463,000 anyway, a small aggregate indeed for an industry which causes such an immense amount of talk and controversy. It employs 15,000 men, however, of whom 60 per cent. are Americans.

The volume is well worthy of further study from its completeness and excellent form, had we space to give to it. We can only hope the 1890 United States census will be as carefully prepared.

PUBLICATIONS RECEIVED.

—*Pamphlet on Wood Preservation.*— Issued by the Carolina Oil & Creosote Co., manufacturers of carbonized and creosoted timber and cross-ties and wood creosote oil, Wilmington, N. C.

—*Report on the Winnipeg Water Power of the Assiniboine River in Manitoba.* By J. T. FANNING, C. E., Chief Engineer of the St Anthony Falls Water Power Co. June, 1889. Pamphlet, 16 pp.

This report was made at the request of a special Committee of the Winnipeg Board of Aldermen, and is a full preliminary treatment of the subject involved. Mr. FANNING recommends a filled crib-work dam, 600 ft. long and 32½ ft. high, not including flash boards 2½ ft. high, with masonry abutments and side walls. This dam would give a fall of 24 ft., which at the ordinary low summer flow, estimated at 2,568 cu. ft. per second, would give 6,986 H. P., or an average minimum flow of 5,000 H. P. gross, or 4,000 net, if reduced to the standard of indicated power of steam engines. This power could be considerably increased by reinforcing the Assiniboine river by water from lakes Manitoba and Winnipegosis. The whole cost of the dam and appurtenances is estimated at $400,000.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The following papers and discussions are announced.

Meeting of Sept. 4. Paper on the "Sibley Bridge," by O. CHANUTE, JOHN F. WALLACE and WM. BREITHAUPT, with discussion.

Meeting of Sept. 18. Discussion on Paper by THEODORE COOPER, on "American Railroad Bridges."

Meeting of Oct. 2. Paper on the "Hydraulics of Fire Streams," by JOHN R. FREEMAN, with discussion.

Meeting of Oct. 16. Paper on "Cast Iron, Strength, Resistance, Tests and Specifications, by Prof. JOHN B. JOHNSON, with discussion.

Discussion on these papers is invited. Advance proofs will be sent to those expressing a desire to discuss either paper. Papers on engineering subjects are invited. They should be presented as early as possible so as to arrange for their presentation and discussion.

American Society of Civil Engineers.—The first meeting of the winter session was held Sept. 4. The paper on "The Sibley Bridge," by O. CHANUTE, WM. WALLACE, and H. BREITHAUPT, which was read at the convention in June, was up for discussion.

The following candidates were elected:

MEMBER.

BUSHROD W. TAYLOR, Eng. of Maintenance of Way, Jeffersonville, Madison & Indianapolis Div., Pennsylvania lines west of Pittsburg, Louisville, Ky.

JUNIOR.

MARIO LORINI, Asst. Eng., Dept. of Public Works, New York City.

Connecticut Association of Civil Engineers and Surveyors.—The fall meeting of the Association will be held at the New Haven House, New Haven, Conn., Sept. 12, 10 A. M. Business meeting. "Commemorative paper on the late SYLVANUS BUTLER," by JOHN R. PATTERSON, New Haven. "Proper Construction of Earth Dams," by HENRY W. AYERS, New Britain. Question: "What degree of accuracy as regards horizontal distances should be insisted on in the ordinary surveys for sewers, water-works, street lines and grades?" by the Special Committee.

1.30 P. M. Visit to the new dam of the New Haven Water Co.

D. BRISSMADE, *Secretary.*

Birmingham, Conn.

Denver Society of Civil Engineers.—At a recent special meeting an extended article on the "Street Pavements of New York," by Professor NEWBERRY, which appeared in the *Columbia School of Mines Quarterly* was read. The pavements of London, Paris and other cities was reviewed at length. Professor NEWBERRY strongly favored asphalt as superior to any other material.

American Institute of Mining Engineers.—The fifty-fifth meeting will be held at Ottawa, Ont., beginning Oct. 1. Dr. JOHN SWEETLAND is the chairmain of the local committee of arrangements; and the secretary, to whom all communications concerning the local arrangements, hotel accommodations, etc., should be addressed, is Mr. B. T. A. BELL, 14 Metcalf St., Ottawa.

The following excursions will be made: Excursion by rail and river to the phosphate mines on the Lievres river; visits to points of interest in and around Ottawa, including the lumber mills, Chaudière falls, government house, parliament buildings, geological survey museum, etc.; excursion to the Sudbury copper mines and the works of the Canada Copper Company, on the Canadian Pacific Railway, with opportunity, to such as desire it, to continue their journey to the Port Arthur silver region on the north shore of Lake Superior; excursion by special trains through the eastern townships, visiting the asbestos mines at Wetford and Colernine, the Oxford copper mines, the Rockland slate quarries the Capelton chemical works etc., and terminating at Montreal or Quebec.

New England Railroad Club.—The regular monthly meeting of the club will be held on Wednesday, Sept. 11, 1889, at the United States Hotel, Boston. Members are invited to bring their ladies.

The committee have arranged for a reception at 6, and dinner at 6.30 P. M., on the above date; subject for discussion, an elaborate bill of fare, after which there will be remarks by distinguished guests.

Tickets may be had of the secretary at $2 each. No wines or liquors served.

It is important that notice of attendance be sent the Secretary by Sept. 9, so that the necessary arrangements can be made.

FRANCIS M. CURTIS, Secretary and Treasurer.

American Association for the Advancement of Science.—This association held its 38th annual meeting, at Toronto, Aug. 28 to Sept. 3. About 400 members were present and nearly 200 new members were elected. The association is composed of 8 sections, A to I, named respectively: Mathematics and Astronomy, Physics, Chemistry, Mechanical Science and Engineering, Geology and Geography, Biology, Anthropology, Economic Science and Statistics. During the convention several papers were read each day before each section, there being a separate hall for each.

It is interesting to note that the association owes its existence to the State Geological Survey of New York; members of this survey formerly meeting annually at Albany to compare notes, and in 1840 joining at Philadelphia with members from other State Geological Surveys, and finally forming the present organization.

In the Mechanical Science and Engineering section Mr. O. CHANUTE read on Thursday, a paper on "The Preservation of Timber," in which he pointed out the necessity for such preservation, and reviewed the methods employed for the purpose, and their effects.

The same day Mr. E. B. PERRY, Bay City, Mich., made a comparison between the performance of steam injectors and a duplex steam pump, and Prof. J. E. DENTON, Hoboken, N. J., read a paper on "The Relative Economy of Modern Air Compressors."

On Friday, in this section, notes were given by W. P. WARNER, Cleveland, O., on "Anti-Friction Construction for Revolving Mechanism for Observatory Domes." Prof. J. E. DENTON read a paper on "The Probable Cause of Superior Economy of Multiple Expansion Engines." During the convention a paper was read before this section by Mr. GUSTAV LINDENTHAL, Pittsburg, Pa., on "Economic Conditions of Long Span Bridges." The paper gave first a historical sketch of bridge building, then a discussion of types most suitable for long spans and the general conditions affecting the design and construction of such. The last part of the paper showed how the type for the proposed North River bridge was selected, and gave a general description and discussion of the same.

A timely paper was read by Prof. J. RICHARDS DODGE, on "Agriculture in the Arid Regions," in which he discussed the various methods of supplying the needed water, naming: (1) irrigation from streams naturally available; (2) storage reservoirs; (3) catch basins for receiving and storing surplus storm water; (4) pumping from subterranean streams beneath the bed of surface streams nearly or quite dry; (5) artesian wells.

At the close of the Convention, on Tuesday, officers for the ensuing year were elected, the principal ones being: President, GEO. L. GOODALE, Cambridge, Mass., to succeed Major J. W. POWELL, Washington, D. C.; Permanent Secretary, G. W. PUTNAM, Cambridge, Mass. (office, Salem, Mass.), reElected; General Secretary, H. CARRINGTON, Bolton, N. Y.; Treasurer, WM. LILLY, Mauch Chunk, Pa.

NINETY-FIVE-POUND STEEL RAILS are being laid on the Northern Railway of France, says the London *Railway Press*, to replace the 70-lb. rails now in use.

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GEO. H. FROST . . . . . BUSINESS MANAGER

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings

Roadmasters' Association of America. — The annual convention will be held at Denver, Col., beginning Sept. 10. Secy., W. Reed, Waycross, Ga.

New England Railway Club, Boston, Mass. — Next meeting, Sept. 11. Secy., F. M. Curtis, Boston & Albany passenger station.

American Society of Civil Engineers.—Regular meeting, Sept. 18. John Bogart, 11 E. 23d St., New York City.

American Institute of Mining Engineers.— The 55th meeting will be held at Ottawa, Ont., beginning Oct. 1. Local Secy., B. T. A. Bell, 14 Metcalf St., Ottawa. Secy., Prof. R. W. Raymond, 13 Burling Slip, New York City.

Boston Society of Civil Engineers.—Next meeting, Sept. 18. Secy., S. E. Tinkham, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting, Oct. 7. "Tests and Observations on Building Stones," J. A. L. Waddell and W. D. Jenkins. Secy., Kenneth Allen, 310 Baird Building.

American Forestry Congress. — Annual convention at Philadelphia, Pa., Oct 15 to 18. Secy., J. W. Harrison, Franklin Falls, N. H.

PUBLIC or private ownership of waterworks is a question now under discussion at Oshkosh, Wis. The *Daily Northwestern* handles this question with considerable caution, and gives as one reason for public ownership the fact that, according to the company's franchise, the city has to pay for the establishment of a new hydrant at the end of every 450 ft. of extension to the mains. This provision is a drawback to extensions in sparsely settled districts, as the city is loth to pay for unnecessary fire protection, and thus people in the outlying districts have water neither for domestic purposes nor for fire protection. This is but another instance of a franchise with insufficient provisions for all contingencies. Oshkosh now has an estimated population of 25,000, and in a city of that size there may be outlying districts needing for their supply a separate main extending half a mile along an unsettled street. On such a main in Oshkosh the company would place 5 hydrants, and collect a rental of $60 each, or $300 per annum. It is evident that the city should have some discretion in such a case. If only good and honest management could be relied on, it would, in all cases, be judicious for cities to run their own water-works, since they are peculiarly enterprises for the common good on which public money may properly be expended; but the difficulty is that not even honest management, and still less good management, can always be assured, so that with proper conditions the public does not suffer much, and often gains, from private ownership. Onerous conditions of the kind above noted put another face on the matter, however.

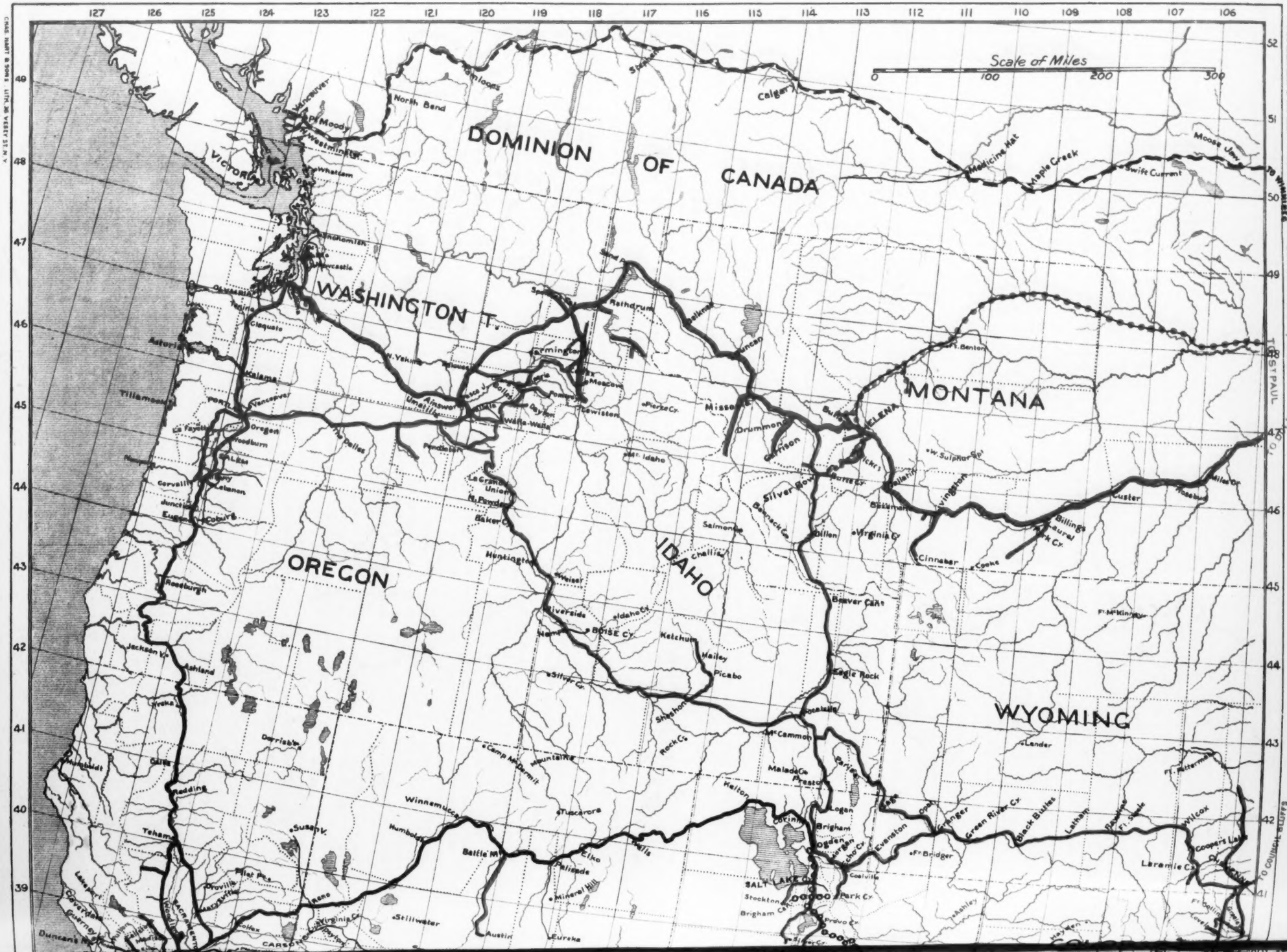
THE failure of the Spring Lake dam near Phenix, R. I., described in last week's issue, forcibly illustrates the point we made two weeks ago in comparing the statute provision in Rhode Island and Connecticut for the State supervision of the construction of dams and reservoirs. We then stated that in this respect alone Connecticut seemed in advance of Rhode Island. In the former State the statute explicitly provides for the examination and approval of the plans, specifications, *and site* of all new structures by a State Inspector, and also for supervision during construction and approval after completion. In Rhode Island the statute of 1882 merely provides that plans and specifications for new structures shall be filed with the commissioner. We have recently been informed by Commissioner STONE that all plans and specifications for new work and for repairs must be approved by him, but the 1882 statute contains no such provision. Had Commissioner STONE been empowered to examine the site of the Spring Lake dam we think he would have insisted on ample provisions against the undermining of the dam at the river bed, which he now says caused the failure: or if there was a spring beneath the dam in any way responsible for the disaster, and especially if this gave the contractors trouble, or if the construction of the concrete heart-wall was slighted by the contractors, against any of these alleged causes of failure he most surely would have guarded.

THE Mayor of Philadelphia has sent some water from the Schuylkill river to Germany for analysis, to determine whether it is really unfit for domestic purposes. The reason for doing this is attributed to his desire for an unprejudiced examination and report, rather than his disbelief in the skill of American chemists. It seems, however, that he might have relied upon some of our eminent chemists, outside Philadelphia, and really have secured far more satisfactory results. For instance, the services of an American expert might have been secured, and the examinations have been made in Philadelphia, thus enabling the chemist to study the sources of contamination to which the stream is liable, and to take his samples of water from points most affected by such contaminations. By this method an intelligent study of the purity or impurity of the water could have been made. It is probable that such examinations have been made; but an analysis being deemed necessary, it is questionable whether the means employed for securing it are the best. It would at least be desirable to supplement the German chemist's analysis by a thorough study upon the spot. It is said that both Norristown and Conshocken drain into the river but a few miles above the point from which the supply is taken for Germantown and Conshocken. Certainly, analyses are in order.

WE give this week some further details of the Flat Creek trestle disaster, including a view of the floor as it was two days after the disaster (the bunched ties having been somewhat readjusted) and as it must have been to a great extent before the disaster. We had intended discussing the moral to be drawn from the facts shown in this issue, but as we cannot extend our space indefinitely, we are compelled to postpone the attempt to do so until our next issue. In the mean time we commend the details given in this and our last issue to the thoughtful attention of those responsible for the safety of structures and trains. While we are glad to know that the Flat Creek trestle floor and track connected therewith was in some important respects far below the average conditions on even the poorest roads, so that derailments were far more likely to occur than at most other such points, yet the train *once off the track*, the conditions there were not materially worse than they are on hundreds and thousands of other trestles, and were so unnecessarily bad that no man ought to rest easy who is responsible for like conditions elsewhere. What more we have to say on this subject we postpone until next week.

THE absurd effort which is now making to prove that 1000 to 2000-volt currents are not deadly, and—still more absurd—that they are a "cruel and unusual" mode of putting criminals to death, has had a curious commentary in the sudden death this week of an electrical expert, Mr. D. A. HENRY, Superintendent of Construction of the East River Electric Lighting Co. This company uses for the most part the direct current, but has recently put in one alternating machine. Something went wrong with the switchboard; Mr. HENRY climbed up on a ladder to fix it; did fix it, but in some way slipped and lost his balance on the ladder, and in his instinctive and convulsive effort to recover it, put his hands on just the wrong points, and received the full 1000-volt current through his body, dying instantly. These accidents are becoming so common that they can no longer in any sense be called "unusual," while death is so instantaneous, and ensues so much more quickly than the nerves can transmit sensation, that it is absurd to call it "cruel," unless indeed that charge might lie against electric companies who unnecessarily leave electric connections exposed to such chance contact by employés. The true inwardness of all this pother is that manufacturers of alternating plant dislike to have the fact of its death-dealing capabilities brought home to the general public by its use in execution. This dislike is perhaps natural, but it really has little solid basis, since all intelligent people understand that all kinds of electric currents are unpleasant things to tamper with, and that the true moral is, proper protection, and not disuse, of the current which is most suitable for given practical uses.

THE late investigation into the cause and prevention of electric subway explosions in this city has led to the conclusion that the gas mains leak, a fact that has long been very apparent to every citizen who has brought his nose at all near any one of the many ditches with which our streets are being perpetually scored. The soil beneath our streets is saturated with gas escaping from leaking joints and faulty fittings of all kinds; and now that this leakage is proven to be dangerous as well as wasteful, it is time some measures were taken to stop it. How to stop it is another thing. Street mains of nearly all kinds leak, from careless caulking of joints,


Scale of Miles
0
100
200
300
DOMINION OF CANADA
WASHINGTON T.
MONTANA
OREGON
IDAHO
WYOMING
NEVADA
UTAH
COLORADO
Vancouver
Victoria
Port Moody
New Westminster
North Bend
Kamloops
Calgary
Medicine Hat
Maple Creek
Swift Current
Moose Jaw
Tacoma
Olympia
Seattle
Portland
Astoria
Walla Walla
Lewiston
Moscow
Spokane
Ashdrum
Farmington
Pullman
Colfax
Dayton
Pomeroy
Asotin
Pierce Cy.
Missoula
Drummond
Garrison
Butte
HELENA
Ft. Benton
W. Sulphur Sp.
Silver Bow
Bozeman
Livingston
Billings
Custer
Miles City
Cinnabar
Cooke
Virginia Cy.
Dillon
Beaver Cañon
Ft. McKinney
Lander
Ft. Fetterman
Evanston
Ft. Bridger
Green River Cy.
Black Buttes
Latham
Rawlins
Ft. Steele
Wilcox
Cooper's Lake
Laramie Cy.
Cheyenne
Denver
Pueblo
Colorado Springs
Leadville
Aspen
Gunnison
Grand Junction
Ogden
Brigham
Logan
Corinne
Malad Cy.
Preston
Soda Springs
Pocatello
McCammon
Eagle Rock
Shoshone
Rock Cy.
Mountain Home
Camp McDermit
Boise Cy.
Idaho Cy.
Ketchum
Hailey
Picabo
Silver Cy.
Huntington
Weiser
Riverside
Baker Cy.
La Grande
Union
N. Powder
Pendleton
Mt. Idaho
Salmon
Challis
Roseburg
Eugene
Corvallis
Albany
Lebanon
Woodburn
Oregon
Salem
Portland
Vancouver
Ft. Dalles
Yakima
Ellensburg
Olympia
Tacoma
Seattle
Port Townsend
Whatcom
Fairhaven
Bellingham
Skagit
Snohomish
Everett
Steilacoom
Tenino
Chehalis
Clequato
Astoria
Tillamook
Klamath
Jacksonville
Ashland
Medford
Grants Pass
Roseburg
Drain
Yoncalla
Oakland
Riddle
Gilbert
Redding
Tehama
Susanville
Winnemucca
Humboldt
Battle Mt.
Elko
Palisade
Tuscarora
Mineral Hill
Pilot Peak
Oroville
Virginia Cy.
Gold Hill
Carson
Stillwater
Austin
Eureka
Ely
Stockton
Brigham
Coalville
Park Cy.
Provo Cy.
Ashley
Hayden
Glenwood Springs
Duncans Mills
Guerneville
Sebastopol
Petaluma
Napa
Vallejo
Benicia
Martinez
Oakland
San Francisco
San Leandro
Alameda
Haywards
San Jose
Gilroy
Hollister
Salinas
Monterey
Santa Cruz
Watsonville
Pajaro
Castroville
Chittenden
Aromas
Soledad
Paso Robles
Templeton
Santa Margarita
San Luis Obispo
Guadalupe
Los Alamos
Santa Maria
Lompoc
Surf
Gaviota
Santa Barbara
Carpinteria
Ventura
Hueneme
Los Angeles
Anaheim
Santa Ana
Orange
Tustin
Riverside
San Bernardino
Colton
Pomona
Ontario
Cucamonga
Azusa
Duarte
Monrovia
Pasadena
Glendale
Burbank
San Fernando
Newhall
Saugus
Castaic
Tejon
Mojave
Lancaster
Palmdale
Victorville
Barstow
Daggett
Yermo
Ft. Irwin
Cajon
Summit
Colton
Redlands
Highland
Mentone
Yucaipa
Beaumont
Banning
San Jacinto
Hemet
Perris
Elsinore
Temecula
San Diego
National City
Chula Vista
Otay
Escondido
San Luis Rey
Oceanside
Carlsbad
Encinitas
Del Mar
Solana Beach
Santa Fe
Rosarito
Tijuana
Mexico
Ft. Yuma
Yuma
Gila Bend
Maricopa
Casa Grande
Tucson
Benson
Willcox
Bowie
Deming
Lordsburg
Separ
Rincon
Las Cruces
El Paso
Ft. Hancock
Sierra Blanca
Eagle Springs
Van Horn
Ft. Davis
Marfa
Alpine
Marathon
Sanderson
Langtry
Del Rio
Spofford
Eagle Pass
Laredo
Corpus Christi
Rockport
Aransas Pass
Port Lavaca
Victoria
Cuero
Yoakum
Gonzales
Seguin
San Antonio
New Braunfels
Boerne
Kerrville
Comfort
Fredericksburg
Llano
Burnet
Lampasas
Georgetown
Austin
Bastrop
La Grange
Columbus
Wharton
Houston
Galveston
Alvin
Pearland
Angleton
Freeport
Brazoria
Sweeny
Bay City
Matagorda
Palacios
Port O'Connor
Port Lavaca
Seadrift
Rockport
Aransas Pass
Corpus Christi
Kingsville
Alice
Falfurrias
Hebbronville
Encinal
Laredo
Rio Grande City
Roma
Mission
McAllen
Edinburg
Harlingen
San Benito
Brownsville
Matamoros
Mexico
Gulf of Mexico
Sabine Pass
Port Arthur
Beaumont
Orange
Lake Charles
Jennings
Crowley
Rayne
Lafayette
New Iberia
Morgan City
Houma
Thibodaux
Donaldsonville
Gonzales
Baton Rouge
New Orleans
Slidell
Covington
Hammond
Ponchatoula
Amite
Tangipahoa
Kentwood
Franklinton
Bogalusa
Columbia
Jackson
Clinton
Vicksburg
Delta
Tallulah
Lake Providence
Monroe
Ruston
Minden
Shreveport
Mansfield
Natchitoches
Many
Leesville
DeRidder
Lake Arthur
Welsh
Jennings
Crowley
Rayne
Lafayette
New Iberia
Morgan City
Houma
Thibodaux
Donaldsonville
Gonzales
Baton Rouge
New Orleans
Slidell
Covington
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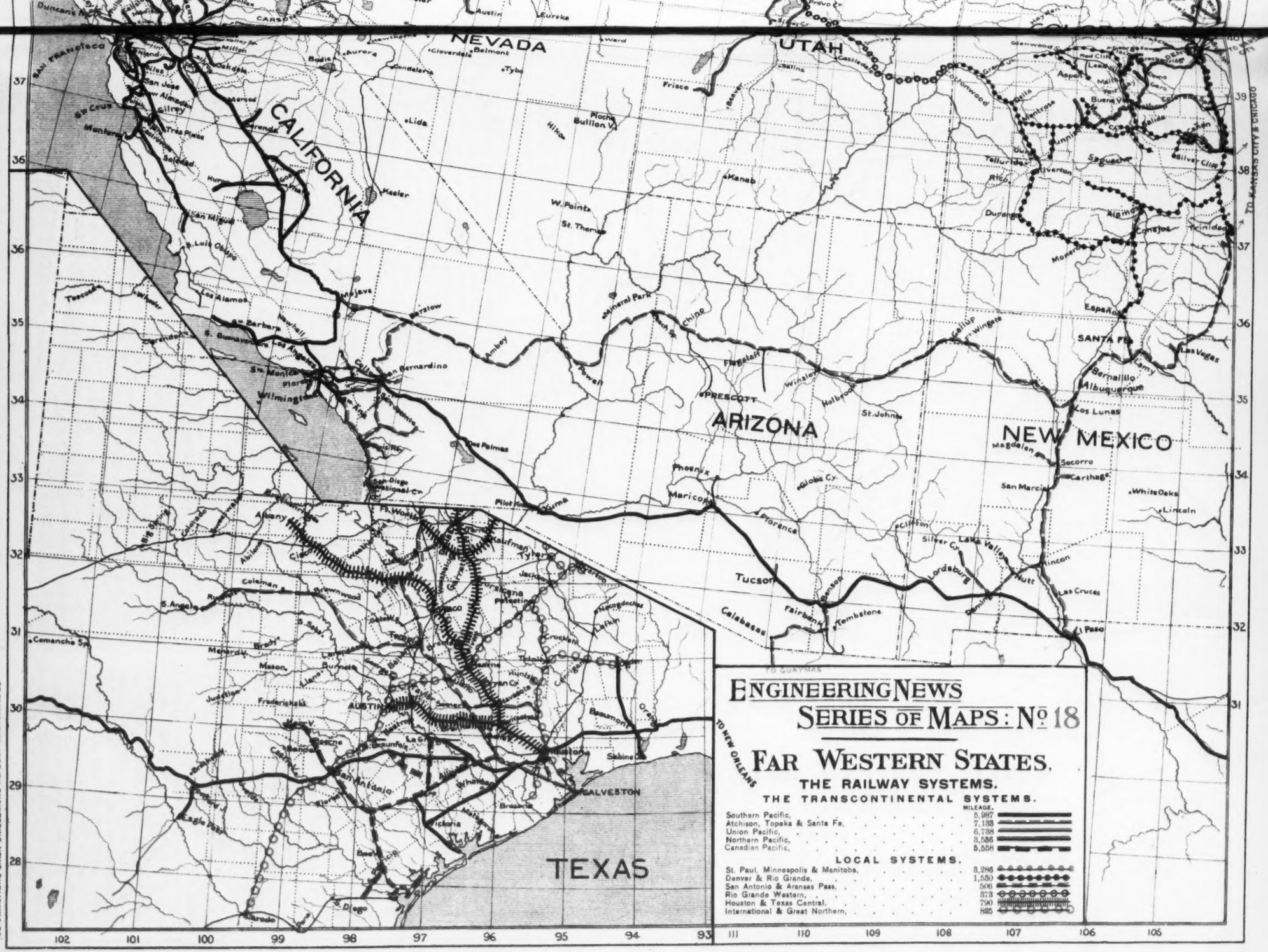
Welsh



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from uneven settlement of material, and from expansion and contraction in the pipe itself. With water mains this leakage usually means waste alone, without especial danger to property or life; with steam it means a nuisance to traffic in the obstruction caused by the necessary immediate repair; but with illuminating gas there is absolute danger in the accumulation of this gas in the nearest subway, sewer, or house vault, an accumulation that only awaits the inevitable spark to bring about destruction of property or possibly life. Aside from the position taken by the Board of Electrical Control, that no one pipe system under our streets should be permitted to endanger or cripple an adjoining pipe line with equal rights, there is an element of danger to the whole public in this leakage of gas that calls for efficient protective measures.

If possible all pipes under streets, for whatever purpose used, should be tight; for a waste of water means also a waste of public revenue, and few, except those who have critically examined a distribution system, realize how much of this precious fluid annually flows off through the sewer nearest to the leak, with no surface indication, a lowering of pressure and waste of fuel being the only evidences of its existence. The steam pipes belong to a private company, and as this company has to pay for all wasted steam, it is to their interest to keep them tight; an interest that should, but does not, except in a very few of our more progressive cities, apply to the repairs of leaking water mains. But gas, even at present rates, seems to be such a cheaply manufactured commodity, and the dividends to its owners appear so liberal, that the companies disregard any leakage, appparently, short of a rupture in a main, and discount the waste as a necessary evil. In our already gas soaked soil, it would probably be a task of serious dimensions to locate every individual leaking joint, even with the rod test; and to repair the leaking joints would mean a ripping up of our streets and a gas-saturated atmosphere that would prove an enormous nuisance and doubtless seriously affect the public health. But if the leakage cannot be stopped, and if blowers are absolutely required to keep the electric conduits free from dangerous accumulations of gas, then the expense of their maintenance should be a charge upon the mischief-making gas mains and their owners, if this charge is to be a permanent one, as the late expressions of opinion in the board would lead the public to infer.

The great Springfield arch question, which has agitated Springfield for months past, and through us has also agitated the world at large, has been settled by proceeding with the construction of the original and very objectionable so-called "Richardson" design. It requires some courage to declare anything which the late H. H. Richardson even sketched to be bad, and were it a building we should not venture to do so, however clear the case might seem to us; for we yield to no one in admiration of his genius, which has led one of the greatest of living English architects to declare him "the greatest architect since Michael Angelo." No one can look at the Pittsburg court-house, for example, to our thinking the most impressive structure on this continent, without keen pleasure in its perfect symmetry. But Richardson made a mere rough sketch for the Springfield arch, if indeed he made any, and the design was really by his successors, who as yet remain mere men like the rest of us, with whom it is permitted to any one to differ; nor does it necessarily follow that the greatest architect should be always great. We recognize no touch of Richardson in the squat monstrosity which is about to deface the city. It is "after" him, perhaps, since it is very massive, but it is a long way after him,—a dead mass instead of a live one. The sketches by Mr. Thos. W. Mann, an engineer and architect of Holyoke, Mass., published in the *Springfield Republican* of April 20, 1889, were to our mind far more worthy of adoption, and in fact really admirable. By an unfortunate accident we failed to receive them in time, or we should have republished them when the question was alive. It is now too late for us to do so to advantage, but it is even yet not too late to change the plan of the structure, should the powers that be come to their senses in time.

The Railway Systems of the Rocky Mountain and Pacific States.

(WITH INSET MAP.)

The portion of the United States shown on the accompanying map has an extent nearly double that included in our previous maps, for though it is uniform with them in size, it is drawn on a smaller scale. This should be remembered when making comparisons of these systems with the others already published, in order that the extent of these far Western railways and the breadth of territory still remote from railway communication in this section may be clearly comprehended.

The topography of the country through which these systems have been built is evidenced by the tortuous routes which they pursue. Compare the systems shown here with those shown on any of our preceding system maps, and it is at once plain that no direct routes like those on the prairies have been open here to the locating engineer. If our map could show the profiles of these lines, the difference between these systems, and those lying on the prairies and along the valleys of Eastern rivers would be still more plain.

Another feature of interest in connection with the five transcontinental systems is the fact that they have all been the recipients of Government aid, either in the form of land grants, or cash, or both: and although they have had but little local aid from municipalities, etc., it is probable that, on the whole, the amount of help they have received is more than that which has been given to the roads of any other section.

Still another peculiar feature of these systems lies in their traffic. On no other systems, not even on the trunk lines, is the proportion of local traffic, as compared with the through traffic, so small as on the transcontinental lines. It is probably due to this, more than to any other reason, that these companies have uniformly failed to satisfy the expectations of their promoters; and it is the development of a local traffic all along their lines, where formerly none existed, more than any other cause, that has of late given these systems a rapid increase of prosperity. The systems of the Northwest and the Southwest have been pushed in advance of civilization, but the pioneer and the homesteader have followed close after. The transcontinental lines have been built across a territory where for hundreds of miles it was not supposed that any important population could ever be supported. The rapid agricultural and mineral development of this supposed desert has been a chief feature of our national development during the past five years and is to be its greatest feature during the coming decade.

It is somewhat doubtful, however, whether the present transcontinental lines will be as important among the railways of this section as the trunk lines are among the railways of the East. The bulk of traffic over them can hardly prove so great as that which now seeks the eastern seaboard from the Mississippi valley; and, moreover, at least three of the systems of the Northwest are bound to reach the Pacific coast before many months, and it is quite likely that the territory which they will open up will prove at least equal in natural resources to that bordering the present transcontinental lines. The country is now much better known than it was when the existing transcontinental roads were located, and it is quite possible that the lines which are yet to be built to the Pacific may have a more favorable alignment and grades, and penetrate a more productive region than those now existing.

THE SOUTHERN PACIFIC.

Beginning with the transcontinental line lying farthest to the south, the Southern Pacific system extends from New Orleans, La. to Portland, Ore., a distance of 3,297 miles The railway from New Orleans to Ogden, Utah, the terminus of the Central Pacific Railway, forms another continuous line 3,267 miles in length. This is considerably the longest continuous line of railway on this continent under control of one corporation The only approach to it is the Canadian Pacific's line from Vancouver, B. C., to Mattawamkeag, Me., 3,240 miles in length. All long lines of other systems fall far below these in length. Even the Atchison's longest line from Chicago to National City, Cal., 2,344 miles, comes short of this nearly a thousand miles.

The system is divided in two grand divisions: the Atlantic system, including all lines east of El Paso, Tex., with an extent of 1,687 miles; and the Pacific system, 4,245 miles, making the total extent of the whole 5,932 miles. Of this a little over 4,000 miles is the mileage of the main line from New Orleans to Portland and Ogden.

The first important line of this system to be built was the famous Central Pacific railway, which was pushed eastward from California to meet the Union Pacific, and formed with that line the first transcontinental railway. Its construction was begun in 1863, and the line was opened for traffic from Sacramento to Ogden, May 10, 1869, the Union Pacific from Ogden east being opened on the same day. The Southern Pacific railway was pushed eastward through southern California, Arizona, and New Mexico, and formed a new transcontinental line by junction with the Texas Pacific at El Paso in 1881.

The Southern Pacific Company was organized in 1884, and leased for 99 years all the lines now forming the Southern Pacific system. It was practically a consolidation of all the component companies into one organization. The men in control of the consolidated company are the same that pushed the Central Pacific across the mountain ranges of eastern California, and the Southern Pacific across the deserts of Arizona and New Mexico, Messrs. Leland Stanford, C. P. Huntington, the Crockers, and others, and a large proportion of the company's stock is still held by them. Besides the mileage included in the above totals, the company owns over one-third interest in the Mexican International railway, extending from Eagle Pass, Tex., to Torreon, Mex., 617 miles, a controlling interest in the Houston & Texas Central system (which is shown separately on our map, as it is now in the hands of receivers), and the Morgan line of ocean steamships, plying between New York and New Orleans and vari-

ous Gulf ports. With the reorganization of the Houston & Texas Central it will probably be formally consolidated with the Southern Pacific Company.

Extensions planned of the Southern Pacific system are principally in the State of California, where the company now holds an undisputed sway, which it probably means to retain. We shall discuss them more fully in connection with our map of the new construction in this section. It is quite likely, too, that the company will take some share in the present activity in Washington Territory, and will at no distant day have its terminus on Puget Sound instead of at Portland.

The Southern Pacific company is of all the transcontinental systems the most prosperous. The following was its record for the year 1888.

Gross earnings from transportation	$64,699,615
Total income	52,670,590
Operating expenses	30,708,670
Total expenses, including interest and rentals	49,998,136
Surplus	2,672,454

THE ATCHISON, TOPEKA & SANTA FE.

This system was fully described in connection with our map of the Southwestern systems, July 20, 1889, and a brief history of the construction of the transcontinental line was there given. The Atlantic & Pacific Railway, which forms the chief part of this line, was completed in 1883. The company also controls the Sonora railway in Mexico, south of the limits of our map. We have also shown on this map the Gulf, Colorado & Santa Fe division in Texas, part of which was south of the limits of our Southwestern map.

THE UNION PACIFIC.

Over one-third of the 6,738 miles of railway composing this great system lies in Kansas and Nebraska and has already been briefly described in connection with the maps of the Northwestern and Southwestern systems. The Union Pacific main line, terminating at Ogden, Utah, was finished in 1869. The Oregon Short Line and the Utah & Northern were built in 1882-1884. The Oregon Ry. & Navigation Company's system was leased by the Union Pacific in 1887.

The Union Pacific's longest line, from Kansas City, to Portland, Ore., is 2,851 miles in length. As seen by the map, the portion of the system west of Denver consists of the main line and four tributary subordinate systems: one in Colorado and Wyoming, one in the region east of Great Salt Lake, the branches to the Montana mining districts, and the system of the Oregon Ry. & Navigation Co., in eastern Oregon and Washington Territory.

The mineral traffic of the company is very heavy; the coal lands in Colorado and Wyoming owned by the company have a greater extent than the total anthracite area of Pennsylvania. It secures an important traffic also from the metal mining districts in Colorado and Montana.

The relations between the company and the United States Government are too complicated for discussion here. What is most to be desired for the good of all concerned is that some permanent settlement be made of the questions at issue. Until that is done, it will not be possible for the company to pursue the aggressive course financially, that it otherwise could. It has at the present time probably more opportunities for the construction of profitable and legitimate extensions than any other railway corporation in the United States. Extended surveys of many of them have been made, but until the stockholders know what action their creditor, the Government, is to take toward them, the money for building these extensions is not likely to be forthcoming. Among the important extensions which have been planned are lines from Fresno, Utah, to Barstow, Cal., joining at the latter point the Atlantic & Pacific Railway; a line from Portland to the thriving cities on Puget sound; a line from some point on the Snake river through southeastern Oregon and northern California to a terminus on the Pacific coast. Besides these, a great amount of construction has been planned on shorter feeders, which will have to be done at an early day or else the territory is likely to be occupied by rival corporations. We shall discuss these various extensions more fully in connection with our map of new construction in this section.

THE NORTHERN PACIFIC

This system was described at some length in our issue of May 18, 1889, in connection with our map of the Northwestern systems; but the larger and most important part of the system lies in Montana and the territories west. No other of the transcontinental lines is throwing out such a fringe of feeders all along the main line as the Northern Pacific. The fertile farming region in Washington Territory and the great wealth of mineral deposits and grazing lands in Idaho and Montana are contributing a traffic to the system which is steadily and rapidly increasing. The great territory of Montana, soon to become a State, already produces more silver than any other State and more than one-fourth of our total production, and one-third as much gold as California. In copper it leads even the Lake Superior district, and produces more than five-twelfths of the total output. The company's only rivals for Montana traffic are the Union Pacific and the St. Paul Minneapolis & Manitoba, and these compete only in the district about Helena. The company intends to retain as much of the traffic of Montana for itself as possible, and to this end it is continuing the work of building feeders and extensions. An important cut-off from Gallatin to Butte is now nearly completed, and surveys are in progress for a 225-mile line from Billings north to Fort Benton, where connection would be made with the proposed road from the coal fields of the Northwestern Coal & Navigation Co., south to the United States. A branch recently put in operation from Laurel, Montana, south to the Cook City mining district is expected to furnish an excellent coal supply to the smelters about Helena and Butte. Many other short branches to Montana mining camps are projected and under survey. In Washington Territory the most important extension under way is the Central Washington Railway, which is being pushed west from a point near Spokane Falls, and opens up the fertile plains of the "Big Bend" country in the valley of the Columbia river. If a satisfactory passage through the Cascade range can be made, this road may eventually become the main line to the coast, with its terminus at some point on Puget sound. The Oregon & Washington Territories Railroad and its branches, which are being built by G. W. HUNT and others in the district about Walla Walla, are practically in the Northern Pacific interest and will probably be consolidated eventually with the main system.

In view of the recent action of the managers of the company in voting to replace their present bonded indebtedness with a new issue, secured by a general mortgage and bearing a lower rate of interest, our map of the system is of special interest. It shows clearly how the branches have been pushed out north and south from the main line, and also the great extent of territory, still undeveloped, which is to be reached by further extensions, funds for whose construction will be furnished by the new bond issue. It shows also the competition which the company has to meet from the Union Pacific on the south and the St. Paul, Minneapolis & Manitoba on the north, and the necessity which the company is under on this account of occupying, if possible, the most favorable territory in advance of its rivals. In one thing, however, our map needs to be studied in connection with the map in the issue of May 11, 1889, to show the real strategic relations of the system to its competitors. The Northern Pacific has a great advantage over its rivals by virtue of its eastern termini. Minneapolis and St. Paul are a more natural market for the tier of States through which the Northern Pacific runs than Omaha or Kansas City. In its direct connection with the Great lakes at Duluth and Chicago, also, the system has an advantage in through traffic to the East greater than is often realized, and one which is likely to play an important part in the system's future.

THE CANADIAN PACIFIC.

This system, comprising the most northerly of the transatlantic lines, was described in our issue of of Nov. 10, 1888 in connection with our map of the Trunk Line systems, on which the eastern lines of the system were shown. A full account of the history and present status of the company was given in a series of articles in Vol. XX of ENGINEERING NEWS and need not be repeated here. The road, which was completed in 1885, is the newest of the transcontinental lines; and the local traffic of the portion included upon our map is much less than that of any of the American transcontinental railways. Nor does there seem to be any likelihood that any considerable local traffic will be developed there for a long time to come. The latitude and altitude of the country make the climate through the mountains too severe for anything but mining and lumbering, and even those occupations are carried on with difficulty. There is, however, a considerable amount of coal and some gold in the territory adjacent to the line, which will eventually be worked to a considerable extent. The district between longitude 116° and 120°, bordering the Kootenay lake and the upper Columbia river, contains much good land and has a comparatively mild climate. It is likely that it will be eventually developed by branches extending south from the main line. It is also hoped and believed in Canada that the vast stretch of plains between Manitoba and Calgary will eventually have a large population.

It will be readily seen that, in view of its meagre local traffic, the Canadian Pacific more than any other transcontinenta lline, has to vindicate its right to live by competing for through traffic to and from the coast. With this in view an extension is already under way south to the American boundary from New Westminster. It will connect with American lines now building north from Seattle and other cities on Puget Sound; and its completion will be a great help to the Canadian Pacific in competing for the traffic from the Puget Sound cities, and in fact for all through traffic to or from the Pacific coast, which now has to be transferred by steamer from Vancouver. Besides the Pacific coast traffic, the Asiatic trade forms a large item in the company's revenue account, and with the establishment of the proposed new line of Pacific steamships, it promises to grow greatly in importance. It is intended in fact that this route shall compete with the Suez canal route for the through traffic between England and Japan and China.

Of the six other systems shown upon our map, one, the St. Paul, Minneapolis & Manitoba, seems likely to take its place at an early

day with the transcontinental lines. The most of the system lies in the Northwestern States, and has already been shown and described in connection with our map of that section, in the issues of May 11 and 18, of the current year. The line to Helena and Butte was built in 1887 and 1888. There is little doubt that one of the first moves of the Manitoba officials, when construction is resumed, will be an extension west to the coast, or possibly to Spokane Falls, to connect with the Seattle, Lake Shore & Eastern. At present the company is exerting itself to colonize the country in northern Montana and Dakota, tributary to the Great Falls extension, and until some progress has been made in developing this, not much is likely to be done on further western extensions.

The Denver & Rio Grande is the only proper local system of much importance in the Rocky Mountain and Pacific States. The total extent of the system is 1,530 miles, all located in Colorado, with the exception of a few miles in New Mexico. The system consists of main lines from Denver south to Trinidad and from Pueblo west to the State line; a long line from Cuchara Junction, through the southern part of the State and the San Juan valley, with two branches to Espanola, N. M., and Wagon Wheel Gap, and a long line from Salida north, extending in a loop which will eventually be finished to the main line at Grand Junction. There are also a number of short branches.

The company was chartered in 1870 and construction began in the following year. On Dec. 31, 1880, the system had an extent of 584 miles. For the next three years construction was very rapid, and 1,371 miles were in operation by the close of 1883. The new extensions proved too heavy a burden for the company, and in the following year a receiver was appointed. In 1886 the company was reorganized, and since then it has been fairly prosperous.

The system is the most important and extensive narrow-gauge railway on the continent. The mountainous nature of its territory necessitated sharp curves and steep grades. The traffic on many of the lines was light, and the great bulk of it was local to the system. These causes combined to make the railway far more successful than any other narrow-gauge railway in the country. The disadvantage of transfers, however, and the competition of standard-gauge lines makes probable the change of the system to standard gauge in the early future. Already nearly 400 miles of the system are laid with a third rail; and the change to standard will probably be gradually made in this way.

The company has completed this year about 60 miles of extensions, and will continue its line at an early date down the Grand river to a junction with the main line. A line is proposed to run from Denver to Salida direct, but its construction is problematical.

There has been much talk of the consolidation of the company with some of the great systems which have built into Colorado from the east, but the chances of such an occurence seem remote. So long as the line is narrow-gauge it is of much less value as a connection than if it wer estandard-gauge, and is worth to any company, therefore, but little more than its intrinsic worth as an investment.

The Rio Grande Western Railway extends from Ogden, Utah, east to a junction with the Denver & Rio Grande system at the Colorado State line. Its total extent is 373 miles. The company was organized in 1881 and in the following year was consolidated with the Denver & Rio Grande system. Two years later the lease was abandoned, at the time of the financial troubles of the leasing company, and the road was put in a receiver's hands. The company has been reorganized and the outlook for its future success is good. Work is now in progress on changing the whole system to standard-gauge, by the laying of a third rail. The new rolling stock is ordered, and the change will probably be made within a few weeks. By an extension of the Colorado Midland Railway down the Grand river to meet this line, standard-gauge cars will be enabled to run through Colorado on the transcontinental trip, which has not been possible heretofore, except by way of the Union Pacific.

The San Antonio & Aransas Pass Railway is properly a Southwestern system, but was south of the limits of our map of that section and is, therefore, shown here on our map of southern Texas. The system is one of the youngest of its size in the country. The company began tracklaying in 1885 and the system has now an extent of 506 miles, consisting of a main line from Kerrville via San Antonio to Houston, with branches south to Corpus Christi, Aransas Pass and points on the coast and a line north from Yoakum, 50 miles, which is under construction to Waco, 120 miles further. Besides this, construction is in progress on a branch to Austin, the State capital, about 75 miles in length, and on another to Llano, 125 miles north of San Antonio. Extensions to Laredo and Brownsville, Tex., and Shreveport or Alexandria, La., are planned and partially located. These extensions, when built, will give the system considerably over 1,000 miles of track. It seems destined to play an important part in the development of the extreme Southwest.

The Houston & Texas Central and the International & Great Northern systems, shown on our map of Texas, were described in connection with our map of the Southwestern systems, July 20, 1889 and need not be further referred to here.

According to Poor's *Manual*, the total extent of railway in Montana, Wyoming, Colorado, New Mexico, and the States and Territories west is 18,985 miles. The mileage of the above described systems included within these limits is 15,071 miles. Add to this latter amount the mileage of the other systems of the Northwest and Southwest in Wyoming, Colorado, and New Mexico, and we have the total mileage comprised in systems in the Far West as 16,145 miles, leaving 2,840 miles, or nearly 15 per cent., as the mileage still operated by independent local companies. This is a larger percentage of independent lines than we found in the Northwest or Southwest, but it is much smaller than that in the older States east of the Mississippi.

Road Making.

The subject of road making is so wide a one that the article relating to it, which we give in another column, should be of very general interest. There is no community throughout the land that would not be largely benefited by improved means of intercommunication and the permanent bettering of the highways. The prevailing nuisance of bad country roads —and city roads too for that matter—is so manifest and apparent that everybody realizes it and complains about it, and yet the evil is allowed to continue, with very little effort for its abatement on the part of those most interested in the adoption of easier means of vehicular travel from place to place.

There are few districts where good materials for road making, either stone or gravel, cannot be found, and in sufficient quantities and of such quality as to warrant large but intelligent expenditures of money in permanent improvements of the public roads. The difficulty seems hitherto to have been a lack of knowledge of the proper rudimentary principles of road making on the part of the executive, and a consequent failure to expend road appropriations to the best advantage.

Hundreds of miles of broken stone and gravel roads have been constructed and are now in course of construction, throughout the country, without any other care being given to the building of them than simply to level off the rough places and to spread over the surface a layer of stone or gravel, as the case may be, and leave this uncompressed layer to take care of itself, or to be kicked about or partly consolidated by the passing traffic. The roadway thus "built" begins by being a hard road to travel, and continues and ends its existence as a nuisance and an interminable expense, and with the admission of everybody connected with it that the road has never been a good road, and that the tax-payers' money has been spent in vain.

The road material has probably been expensively carted a considerable distance by horse power, instead of by properly built traction engines for the purpose; the earth road-bed has probably been allowed to remain soft and unrolled, and on this loose and uneven surface the broken stone or gravel has been strewn, there to remain uncompressed, and the road thus unfinished and unrolled, simply because the authorities in charge could not afford to buy a steam roller for the proper prosecution of the work in which they were engaged. They have, in point of fact, been given perhaps $100,000 to expend in road making, and they cannot see that it was either necessary or desirable to incur an outlay of a small sum in the purchase of proper tools wherewith to do their duty.

And so their slip-shod methods and their false economy lead to the waste of appropriations, and there is nothing to show for it but another miserable example of the art how not to do it.

The methods—the better and more recent methods—of making and maintaining roadways are so simple, and withal so inexpensive and economical, that there ought to be no excuse for anybody engaged in the improvement of highways or pavements adhering to working on any other than the most approved principles of road making.

We have to turn to England and to Europe to fully realize what good country roads mean, and to learn how they are made; though it is pleasant to know that there are American engineers well versed in the art who stand ready to build roads equal to the best when the means are put at their disposal, and good roads are multiplying in the vicinity of our greater cities. The character of a country road will depend altogether upon the material put into it and the manner in which this material is applied. But in the Northern States, where stone is usually abundant, a first-class roadway usually implies the use of the Telford-Macadam system of road-making, a short description of which is elsewhere given in this issue, together with some of the tools essential to its proper construction and maintenance.

CORRESPONDENCE.

Formulæ on Portal Bracing—Correction.

To the Editor of Engineering News:—

Canton, O., Aug. 27, 1889.

As no one else seems to have done it, I will call your attention to an error in the formulæ on portal

bracing in your issue of July 13, page 27, third column.

The expression for $F = F'$ should be,

$$\frac{R \sin \propto d}{A\,B} = \frac{P}{2}\left[\frac{x+y}{A\,B}\right]\frac{d}{a} \text{ or } \frac{P}{2}\left[\frac{x+y}{2a+d}\right]\frac{d}{a},$$

and the expression for bending moment in beam $A\,B$ at G or H,

$$\frac{P}{2}\left[\frac{x+y}{2a+d}\right]d$$

Very truly yours,
J. W. PEARL.

Notes and Queries.

X. Buenos Ayres.—Rope Ferries worked by a river current are a very simple matter. All that is needed is a wire or other rope straight across the stream, and an adjustable attachment to pulleys running thereon of the bow and stern of a flatboat, or any other kind of boat. By so regulating the pulley connection that the front end of the boat points up stream at an angle of about 45° with the current, it is obvious that the current will tend to push the boat across at about its own velocity; and on reaching the other side it is only necessary to reverse the slant of the boat, to have the current push the boat back again; the bow being always close-hauled up against the cable, and the stern at some distance therefrom. A center board, or equivalent side attachments, makes the process surer and quicker. The precise angle which is most advantageous depends upon the current and the boat, and may be quickly determined by trial.

S. P. M. inquires:—Can you tell me if there is published a table where the strains are already calculated out on spans from 50 to 200 ft. iron bridges. I frequently need to put in my bids so quickly that there is not time to make the calculations and it would save me much labor.

We do not know of any such publication.

C. E., TACOMA:—We have often given our ideas about the use of the initials C. E. As a self-conferred degree their use is improper, now that there is a National Society which by admission to membership gives what is in effect the degree of "M. Am. Soc. C. E.," the only degree which means anything as to a man's qualifications for responsible work. As a degree conferred by college on young men without experience after three or four years' elementary study, its use is perfectly proper so far as those holding it are concerned, but it means nothing, and the conferring of it in the loose way in which it is conferred is, we hold, most improper. A lie is made no more respectable by being engrossed on parchment, and solemnly certified to by a President and Faculty. If a reference is made to Vol. LXXV. Proc. Inst. C. E., page 129, the following will be found, which in meaning and intent corresponds precisely with our views:

"The Council desire to draw public attention to the fact that the use of the letters "C. E." is an assumption which is not founded on any qualification, and thus is one calculated to mislead. It should be the aim of all who hold the diploma of this Institution to discountenance such a custom, and always to adopt the official designations, or the abbreviations proper to their class, which are, for a Member, 'M. Inst. C. E.' for an Associate Member, 'Assoc. M. Inst. C. E.,' and for an Associate, 'Assoc. Inst. C. E.'"

The Floor of the Flat Creek Trestle.

The accompanying plan of the floor of the trestle at Flat Creek, on the Knoxville, Cumberland Gap & Louisville R. R., where the accident occurred, on Aug. 22, described and illustrated in last week's issue, was made from measurements carefully taken the second day after the accident. We also show a side elevation of the substructure. The sway bracing is not shown, as no measurements were made of it; the substructure below the floor not being involved directly in the cause of the accident. The bracing is clearly shown in the photographs engraved last week, being simply longitudinal bracing along the outside of the bents, of scantling spiked on, and some light diagonal bracing on the stream span.

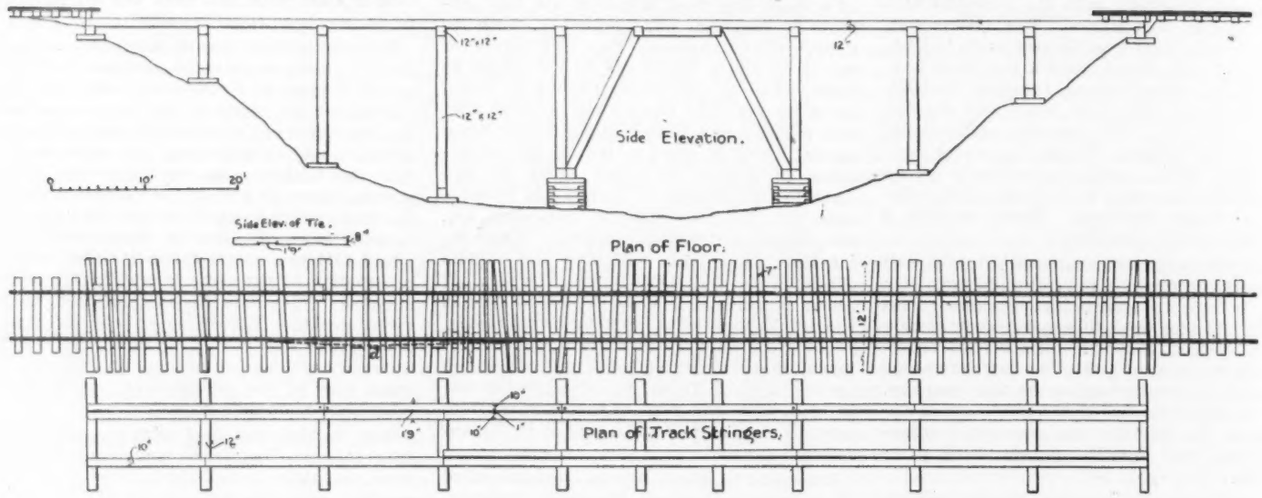
There seems little fault to be found with the construction of the trestle below the floor, which seems solid and substantial; but the floor itself is a good text for a sermon. As we intend to preach a short one on it next week, we will say no more about it here, except to add that the drawing is made from measurements taken after the disaster, which accounts for part of the displacement.

The train was moving north or toward the right of drawing, and the dotted line at d indicates the bending of the rail that was replaced by another. The bent rail was of steel (60 lbs.), 30 ft. long, and had a permanent set of 5¾ ins. outward at the point d, 12 ft. from the south end of the rail, where the wheels let go. d is 30 ft. from south end of trestle.

The bridge ties appear to have been "bunched" from the south end of trestle to a point a little north of d, although it is not easy to see how this could have happened to the right of the point d, as no derailed wheels passed over that part of the structure.

The finding at the coroner's inquest on the accident was as follows:

That deceased came to his death by an accident and wreck upon the Knoxville, Cumberland Gap & Louisville Railroad, on August 22, 1889. That said accident occurred at the third crossing of Big Flat creek, in Granger Co., Tenn., and from the proof we discover no cause for the accident, and find the same to have been unaccountable and unavoidable.



The Flat Creek Trestle; Knoxville, Cumberland Gap & Louisville R. R. Scene of the Fatal Accident on Aug. 22.

THE "Economic Theory of the Location of Railways" is temporarily out of print, the third revised edition being exhausted. The fourth is being printed, and will soon be ready for delivery.

A TIDAL WATER-WHEEL, driven directly by the tide, is in operation at Bowdoinham. It is 27 ft. in diameter and has blades like a propeller, its axis being parallel to the current. It is placed in a narrow estuary, where the tide runs very swiftly. It is said that the wheel gives 50 H. P., and that it is in motion 18 hours a day.

The Drainage of New York City.

A complete examination of the drainage system of this city has recently been made by Mr. RUDOLPH HERING, and a report on the same submitted by him to Commissioner of Public Works GILROY.

A part of the report is historical, beginning with a description of the first attempt in 1676 to drain from the low areas of the island the accumulation of storm water. In 1865 the Legislature authorized the city to adopt a general system of drainage, which extended over only those localities not already sewered. At that time there were about 200 miles of sewers and 2,500 catch basins. In 1870 the Department of Public Works was given control of the sewers, from which date many improvements have been made.

The earlier sewers were built each for its special locality, without regard to other parts of the city, so that there are really many separate systems. Most of the sewage is discharged into the docks, and considerable trouble is caused by the precipitation of heavy matter. Other difficulties are insufficient size of the old sewers, their present dilapidated condition and bad junctions, the latter retarding the flow in the main sewers; and the great quantities of refuse of all descriptions that find their way into the sewers.

In his examination Mr. HERING made some interesting and valuable experiments regarding the minimum and maximum velocity of the flow in the sewers, and also regarding the relation of the rainfall to the flow. He found that with proper construction and attention the minimum flow might generally be made to have a velocity sufficient to prevent deposit, as the grade is, in most cases, ample for this purpose. The outfall sewers present very low grades and demand special attention.

On an area of 221 acres, comprised in one district, the average time in which the water from the extremes reached the sewers was from 8 to 10 minutes, when the sewers were half full. The estimated average time in which water falling upon roofs and gutters reached the sewers was from 6 to 8 minutes.

Several rain-gauges were placed upon the roofs of buildings in the above district, and during the period the greatest discharge was 1.17 cu. ft. per second per acre. The greater the intensity of the rain for a short space of time, the less was the percentage which reached the sewer at its maximum flow.

As the intensity of the rainfall varies almost continually, a heavy uniform fall, rarely lasting over 10 minutes, self-recording gauges were used to determine the maximum fall the sewers should be able to receive. The highest records were 3 ins. in 1 hour, 2 ins. in 30 minutes, and 1 in. in 10 minutes. In England allowances have been made for a rainfall of 1 in. an hour, while in Paris the assumption is that a maximum of 1.77 ins. falls in 1 hour, and ⅙ of this amount reaches the sewers during their

maximum flow. The allowance in Berlin is for ⅛ in. per hour to reach the sewers at one time, and at Vienna ⅛ in. per hour is supposed to fill them. Coming to this country, in New York, in 1868, it was estimated that from a rainfall of 1 in. per hour, 78 per cent. of the average fall reached the sewer each second on areas of 5 acres, and that the quantity gradually diminished, till on an area of 300 acres it would be but 20 per cent. In Philadelphia the sewers are proportioned to receive from all areas an amount of water equal to a rainfall of 1 in. per acre per hour. In Providence the assumption is that from 50 to 80 per cent. of the maximum rainfall reaches the sewers each second.

A list of sewers within the city that are in improper condition covers 7 type-written pages, and includes such causes as general dilapidation, and the entrance of steam and objectionable manufacturing refuse. Mr. HERING thinks that by remodeling these imperfect sewers the system can gradually be brought to a high standard of perfection.

Brock's Pipe Wrench.

The Brock patent improved pipe wrench is an improvement upon the old-fashioned pipe tongs, and is used for gripping, turning or holding pipe, bolts, bars, shafts, or other round pieces from ⅛-in. to 14 ins. diameter. It consists of a straight steel bar, forming the handle, with an enlarged head at one end; this head is fitted with a toothed shoe which gives a secure grip on the pipe. At the back of the head is a clutch, to the lower end of which is attached a steel chain made of flat plate links, the upper edges of the links forming hooks. In using the wrench, the toothed face of the shoe is placed on the pipe and moved forward against it until the pipe touches the lower part of the clutch, throwing it back and raising the clutch; the free end of the chain is then passed round the pipe and slipped under the cross-bar of the clutch; by drawing the wrench slightly back or downward the clutch is lowered, the hooked links take hold of this cross-bar, and when the wrench is given an upward movement, the pipe is firmly gripped and turned. By pushing the wrench against the pipe, the clutch is raised and the chain released. The operation is simple and is rapidly performed, while the pressure is applied to the pipe in such a way as to minimize the danger of crushing it. The wrench can be used in any position.

Being made entirely of bar steel, it is light, strong, and durable. The toothed shoe is a drop forging made from crucible steel and hardened to a temper: it does not wear quickly, but when necessary it can be removed and a new one fitted to the head. The chain is also made of crucible steel; the links are flat and are secured by flush rivets. The working strain is on the top of the chain and not on the heads of the rivets.

The wrenches of each class are made of uniform dimensions, and the chain, clutch, or shoe may be readily removed, and replaced by a new one at a small cost. They are already in extensive use, and the manufacturers are increasing the capacity of their plant. They are made in five sizes: the smallest takes ⅛-in. to ¾-in. pipe, and costs $2.50; the largest takes 2-in. to 14-in. pipe, and costs $18. Extra chains and shoes cost from 50 cts. to $3 each according to size.

The use of drop forgings for the shoes is an interesting feature, this system of forging being a modern process enabling large numbers of pieces of precisely the same form to be turned out at a low cost, while the forged metal is very strong and durable.

Any further information in regard to the pipe wrench, or to drop forgings in general, may be obtained of the manufacturers, Wm. H. Brock & Co., 7 Seabring St., Brooklyn, N. Y.

Seven Years of Litigation between the City of New Orleans and the New Orleans Water Company.

For seven or eight years the city of New Orleans and the New Orleans Water Co. have been in litigation regarding the terms at which the company should supply the city with water.

The first water-works in New Orleans were built in 1833 by a private company. In 1868 the city bought the works from the Commercial Bank, paying $1,300,000. For 10 years the city operated the works, but bad management resulted in an insufficient supply of water and heavy debt. In 1878, after continued complaint from the citizens regarding the inefficiency of the works, the city induced the holders of its water bonds and other water debts to exchange their claims for stock in a company organized to own and operate the works. The company issued stock to the amount of $2,000,000, or 20,000 shares, and the city retained and still owns 3,927 shares of this stock.

In the act passed by the Legislature of Louisiana, enabling the city to sell the works, one section provided that the city should have free water for public use, and further that "in consideration thereof the franchise and property of said New Orleans Water-Works Co., used in accordance with this act, shall be exempt from taxation, State, municipal, and parochial." About three years later, in violation of this latter provision, the city sued the company for taxes for the year 1881, to the amount of $11,000. The company then demanded $40,000 for water furnished the city in the same year. After going to the State Supreme Court, it was decided that exemption from taxation, as provided by the company's charter, was constitutionally illegal, and that the company must pay taxes for 1881 and thereafter. It was also decided that the company should be paid for all water used by the city, but, since the evident intention of the charter was that taxes should be offset by water used, it was ruled that the city should pay water rates each year to the amount of the taxes for that year. From this ruling the company appealed to the United States Supreme Court, where the matter is still pending.

In 1884 the city secured from the Legislature the right to contract with the company for water at a fixed annual charge of $60 per hydrant. Recently one ED. CONERY, and others, styling themselves "The Committee of One Hundred," attacked the validity of the contract, claiming that the Legislature had no right to authorize the city to enter into a second contract after the courts had interpreted the meaning of the first, and urging that the new rental, which amounted to about $70,000 a year, was a donation to the company. The company pleaded "No cause of action," and the lower court dismissed the case. The committee appealed to the State Supreme Court, and the case was sent back for trial. At this point the city joined the committee. The lower court decided in favor of the committee, the company appealed, and the State Supreme Court decided, 3 to 2, in favor of the company and the legality of the contract. It was held that there were no grounds for federal jurisdiction, and the City Council instructed the City Attorney not to carry the case to the United States Supreme Court. But the committee have proposed to so carry the case, and in June the mayor, JOS. A. SHAKESPEARE, sent a special message to the City Council, objecting in strong terms to a stay of proceedings. Immediately after the mayor's message, R. E. CRAIG, president of the company, wrote to the mayor, claiming unfair treatment from the city, and offering to deliver the works over to the city, the stockholders to receive again the bonds and other claims they held against the city in 1878. No further action has been reported, and the company has since been improving its works.

To summarize briefly, it seems that after the company had been in operation two or three years, the city felt that it had made unnecessary concessions, and determined to secure the payment of taxes. Being beaten, it was willing to make a new contract, and pay a much higher rental than the amount of the taxes, but there was opposition to this contract, which resulted in the suit by "The Committee of One Hundred." A change in the city government brought the opposition into power, so that the city joined the committee. At the first, the litigation seems to have been the result of a desire to obtain from the company water free of charge, and after being beaten in this to obtain it at a nominal rate. Undoubtedly the Court's decision that the rental should equal taxes was in accordance with the intent of the charter; but the city violated this provision, and in any case the company is not to be blamed for securing a more favorable contract, when that was possible, and with the Legislature's sanction it certainly had a right to do so.

The original contract, or charter, was drawn in 1878, and this was ten years later than the passage of the legislative act providing that no corporation should be exempted from taxation, on the strength of which the Court decided that the taxes must be paid. There was, therefore, no excuse for such a blunder.

With the increase, in later years, of the granting of franchises, greater care has been taken to insure the legality of their provisions. That this has been necessary is shown by the case before us, which is all the more emphatic since New Orleans is so large a city, and the amounts and interests involved have been so considerable. That there is yet need of lessons in this line is shown by the fact that within a year a Vermont town has had trouble with a water-works company over a provision in the latter's franchise which stated that the hydrant rental should be the same as, or no more than, that paid by other cities of its size.

The New Orleans Water Co. now has about 1,200 hydrants, and the rental of $60 each is undeniably a comparatively high one, as the average rental for the United States is less than $50 a year. But it should be remembered that the number of private consumers in New Orleans is very low, there being but 1 tap for every 49 of the 1880 population, while in the whole Southern States there is one tap for every 12.2 of the 1880 population on water-works, and in the whole United States 1 tap for every 7.11 of the 1880 population.

These years of litigation have retarded the New Orleans Water Co. in making improvements, as it could not be expected to enter into them with much spirit, when the city was attacking the validity of its charter, and refusing to pay for the water used. Consequently, public and private consumers have had a poorer water supply during all these years than they otherwise might have had, and it will be some time before the company can gain the ground that it has necessarily lost. Thus the city has gained nothing, but instead, now pays a higher rental than before it began the suits, and it has poorer water service, because the company has less efficient works. A legally-drawn contract or charter, at the first, would have saved all these difficulties, as would a less grasping or evasive disposition on the part of the instigators of the suit.

We are indebted to L. H. GARDNER, Superintendent of the New Orleans Water Co., for the main facts given herein.

Steel Making in England.

[From a London Correspondent].

The Iron and Steel Institute of Great Britain, which has just held its spring meeting in London, is a society Americans will be apt to look upon just now with more interest than most of the other technical or scientific institutions of this country. Next year, in response to a most cordial invitation from the American Institute of Mining Engineers, the members of the Iron and Steel Institute are to visit the United States. This will be the greatest event in the history of the Institute, and at the recent meeting the talk in the lobby—and there is generally a great deal more talk in the lobby than in the theatre—was all of the wonders to be seen next year when the members cross the Atlantic.

This summer the Institute goes to Paris, of course; every one goes to Paris this year; but the anticipations of the exhibition and the Eiffel Tower seemed to count as very little in comparison with those of the American trip.

There was a fair list of papers down for reading at the meeting, but two of these stood out with additional prominence from the influence they may have on the steel making industry of this country, and, indeed, of the world. The first was a contribution from Mr. JAMES RILEY, the manager of the Steel Company of Scotland, which is one of the most famous and enterprising steel making establishments in Great Britain. It may fairly be said that whatever degree of prosperity the company has reached is due, in a very large measure, to its manager. Had it not been for Mr. RILEY, the use of steel for ship building would probably have been delayed for several years; at any rate, he did much at a critical time to smooth the way and lessen the trouble of naval architects by successfully producing steel ship plates when the difficulties attending

the manufacture were far greater than they are now. Mr. RILEY is one of the most active members of the Iron and Steel Institute, and certainly one of the most popular. He has an impetuous manner of speaking, and any one attacking him may rely on a pretty hot encounter: he carries the war right into the enemy's country.

It becomes us, however, to speak rather of Mr. RILEY'S paper than of its author. Its title was "Alloys of Nickel and Steel," and it gave the results of some experiments which had been made at the works of the steel company of Scotland.

Engineers have not been disposed to regard nickel as a desirable element when alloyed with iron, unless for parts that were to be polished, although it was a substance that did not occur often enough to cause anxiety; but the rude manner in which chemists and metallurgists shatter our ancient articles of faith nowadays prepares us for the acceptance of almost any theory. The attempt to produce nickel steel is no new thing, but certainly very few, even of the members of the Iron and Steel Institute, were prepared for the results Mr. RILEY recorded.

Tables and diagrams were exhibited during the reading of the paper in which the record of the tests made were set forth. We shall select a few only of these results to deal with here. It should be first stated that steel was all made by ordinary open-hearth process.

In one heat the steel contained 4.7 per cent. of nickel, 0.22 per cent. of carbon, and 0.23 per cent. of manganese. So far as the percentage of carbon is concerned, this would be a fair example of mild steel, which would give when annealed a breaking strength of about 30 tons, with an elastic limit of 16 tons and an extension of about 23 per cent. on an 8-in. test piece, and a contraction of area of 48 per cent. The nickel alloy actually gave in tensile test as rolled an elastic limit, 25.1 tons, a breaking strain, 40.5 tons, and an extension of 17.75 per cent. in an 8-in. specimen. With tests rolled and annealed from the same composition, the contraction of area was 44.8 per cent., the elastic limit, 28 per cent., and the breaking strain, 40.6 per cent. The extension in 8-in. was 20 per cent. It will thus be seen that the addition of 4.7 per cent. of nickel raised the elastic limit from 16 up to 28 tons and the breaking strain from 30 up to 40.6 tons without impairing the elongation or contraction of area to any noticeable extent. Somewhat similar results were obtained on a 3 per cent. nickel steel with the carbon increased to 0.35 per cent.

Engineers will not be slow to appreciate these really extraordinary results, but probably the first question they will ask will be, What is to be the cost of this material which possesses such great virtues? Unfortunately our information on this point is not very conclusive. Mr. RILEY was asked the question at the meeting by the manager of another large steel-making company, but he evaded the question by saying that commercial details were forbidden by the rules of the Institute. The nickel itself, however, costs, we understand, about two shillings a pound; that is, in the state it is used in the manufacture, which of course is not that of pure nickel. So far as can be judged, the addition of nickel does not add to the cost of working. Mr. RILEY says that the alloy can be made in any good open-hearth furnace working at a good heat. The charge can be made in as short a time as an ordinary scrap charge of steel, say about seven hours. Its working demands no extraordinary care; in fact, not so much as is required in working many other kinds of charges, the composition of the resulting steel being easily and definitely controlled. No special arrangements are required for casting. If the charge is properly worked, nearly all the nickel will be found in the steel, almost none being lost in the slag. In this respect the working of nickel steel differs greatly from that of chrome steel.

Nickel steel is steady in the mould; it is more fluid and thinner than ordinary steel; it sets more rapidly and appears to be more thoroughly homogeneous. The ingots richest in nickel are a little more "piped" than in ordinary steel, but we are told there is less liability to serious trouble from this cause as there is less liquation of the metalloids. Scrap can also be remelted without loss of nickel. The importance of the latter fact will be at once appreciated, remembering that scrap and old material have a value for remelting in proportion to their contents of nickel. It would also seem that no difficulties arise in subsequent treatment, such as reheating, hammering and rolling. It lends itself well to the two latter processes, whether containing little or much nickel; supposing, of course, it be properly manufactured.

In the table of tensile tests, Mr. RILEY had hung on the walls of the theatre, results were given of steel ranging from 1 per cent. to nearly 50 per cent. of nickel. The instance we have already quoted is perhaps the most important. Two of the test pieces, one with 2 per cent. of nickel, 0.90 per cent. of carbon, and 0.50 per cent. manganese and the other with 4.0 per cent. of nickel, 0.85 per cent of carbon, and 0.50 manganese, showed metal too hard for machine or Mushet steel, but was excellent material for tools when tempered at a dull red heat in boiling water. In a sample having 10 per cent. of nickel, and the carbon reduced to 0.50 per cent. (manganese being also 0.50), the same hardness was observed. Of other samples, however, containing greater and less percentages of nickel or carbon, we have no information to the same effect. Mr. RILEY states, however, that the quality of hardness obtains as the nickel is increased until about 20 per cent. is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile, and even to neutralize the influence of carbon. It is, however, to the lower nickel steel that practical working engineers will mostly turn their attention, at any rate until the price of the alloy is reduced to considerably less than half a dollar a pound.

Mr. RILEY hopes, by hardening and tempering, to very largely raise the breaking strain and elastic limit of these alloys. One example he showed, which had been treated in this way, gave a breaking strain of 95.6 tons, and an elastic limit of 54 tons. The extension was 9.37 per cent. in 4 ins., and the contraction of area 49.2 per cent.

A table was also exhibited giving results of torsion tests. Speaking generally, these are in accordance with the results obtained by the tensile tests, the number of twists corresponding closely with the ductility, as shown by extension.

There is one important point which will appeal especially to the ship builder, supposing always the commercial question can be satisfactorily solved. The plates rich in nickel are said to be practically non-corrodible, and even those poor in nickel are much better than other steels in this respect. This question of corrosion is one that has been giving ship owners much disquietude lately. There is no disguising the fact, to which recent evidence points, that a steel ship is in more danger from corrosion than an iron one. The case of our big war ship, the *Nile*, and experience on many merchant vessels, both with regard to exterior and interior corrosion, has caused considerable uneasiness lately, so much so that ship owners have, in one or two instances, talked seriously of going back to iron. We know a good deal more than we did a short time ago about corrosion, but that is not saying much. By pickling to remove mill scale and weathering in the open air, steel plates, bars, and angles may be greatly improved in this respect, so that, with due and careful attention, they will be liable to no especial danger. But due and careful attention is what ships cannot always get, and if we could obtain, at no excessive additional cost, nickel steel that would stand fairly well, it would insure it a large market, irrespective of its other virtues. It is to be feared, however, that the quantity of nickel required to produce a palpable improvement will be too large to bring the alloy within the limits of practical application, so far as this single quality is concerned. However, this remains for future experience, both of a physical and commercial nature, to determine. It is to be hoped that if a large demand for nickel arises, an extended range of supply may be established. This, of course, does not necessarily follow, and increased demand may simply mean increased cost. This, however, is a point into which inquiry will have to be made.

In any case, it can hardly be doubted that in nickel steel we have most valuable addition to the materials at the disposal of engineers.

BASIC STEEL.

The second important paper to which we have made reference was contributed by Mr. J. H. DARBY, the managing director of the Brymbo Steel Works, which are situated near Wrexham, in North Wales.

The Brymbo Works have been laid out especially for the manufacture of basic steel; and, it may be added, have been especially successful in the production of that material. For a long time basic steel made very little headway in this country, in that respect sharing the same fate as the Bessemer steel, and indeed most important inventions; for vested interests are strong here, and the natural attitude of Britons towards change is, in general, one of hostility. This feeling was strengthened in this case by the failure of a certain number of ship plates made by the basic process For a time basic steel was never mentioned in public or private without allusion to this unhappy batch of ship plates, which were held up as an awful example; indeed, we believe one gentleman used to attend the meetings of the applied science institutions for that purpose. The Admiralty and Lloyd's Registration Society also took an attitude of hostility, and people at last began to think that, because this especial make had gone wrong, basic steel was as good as dead and buried; and so possibly it would have been had it not been for our unpleasantly pertinacious neighbors, the Germans. They laid hold of the basic process, and, in spite of failures at first, forced their stuff even into our own market, until at last we were obliged to take the matter up in self defence.

Perhaps the principal thing that militated against the introduction of the basic process was that it was looked upon generally as chiefly applicable to the Bessemer process. As most of the readers of ENGINEERING NEWS must be aware, this process is designed to enable phosphoric ores to be used for steel making. For ordinary Bessemer and Siemens-Martin steel making, hematite ores, which contain practically no phosphorus, have to be used. In England such ore is not widely distributed, the chief deposit being in the celebrated Cumberland district. For this reason we have for years past been importing vast quantities of hematite ore from abroad, chiefly from the well known Bilbao workings in North Spain. By means of a basic lining, in place of an acid lining, to the converter, it was hoped that the Cleveland iron stone and other ores might be used for steel making, and this was done to some extent. The product was not altogether satisfactory, and the most far-sighted amongst steel makers predicted that the basic process would find its true application in the Siemens-Martin or open-hearth furnace, in place of the Bessemer converter. This prediction has been to a great extent fulfilled, and when the present writer visited the Brymbo works a short time ago he found only Siemens-Martin furnaces in operation.

In working the open-hearth furnace on the basic principle, one of the chief difficulties has been the joining of the basic and acid portions. Basic material is not suitable for the furnace roof because it will not hold together sufficiently well to support itself under the stress of ordinary work. As the bath of metal and slag does not come in contact with the roof, it is not practically of great importance of what it is made, supposing it to be a material sufficiently refractory to withstand the great heat of the gas flame, and provided, of course, it will keep in place. A silicious or acid roof is therefore used; but in order to carry out the process, a basic material is necessary for the bottom. Naturally, there must be a junction between the two, but unhappily the acid and basic materials act and react on each other in such a manner that the furnace lining is rapidly destroyed at the line of contact. This for a long time was a great obstacle to the success of the system, but at Brymbo it has been got over, very ingeniously, but very simply, by interposing a zone of neutral material. For this purpose chrome ore has been used, a layer of about two inches thick being interposed between the shrunk dolomite, which is the basic material, and the silica bricks forming the acid part.

The following description of the mode of construction of the furnace is abridged from Mr. DARBY'S paper. The furnace proper is composed of two wrought-iron sides supported by back staves. The ends are left open and the plates are cut away to allow air to circulate for cooling purposes under the furnace bottom and bridge plates. The bottom of the furnace is built up

of cast-iron plates supported on girders. The silica blocks at each end of the furnace are built in the usual manner, but the roof and side walls are built after the hearth has been rammed in. The former is placed some way above the metal so as to avoid splashings of the basic slag. The roof is level from block to block; the ends, however, are well inclined, to bring the flame down on the metal. On the iron plates for supporting the dolomite hearth, fire bricks are placed, so that no part of the basic hearth when finished is more than 15 ins. thick. Hard burned dolomite, well ground, and mixed with as little anhydrous tar as will make it stick together then pressed, is rammed with hot irons until the desired shape of the hearth is built up. The shrunk dolomite is brought to the height of the bottom of the doors all round, and on it a layer of chrome ore, ground fine and mixed with tar, is rammed. Chrome ore is also rammed in between the silica blocks and the basic hearth. The side walls and jambs are built of crome ore. The roof is then put in and the furnace heated up gradually. There should be no stopping in putting in the hearth and finishing the roof. A 20-ton furnace should thus be completed in 34 or 40 hours.

The pig used at Brymbo for the manufacture of this basic steel is made from Northampton and local ores. The following is given as analysis.

	per cent.
Carbon (combined)	3.20
Phopsnorus	3.00
Sulphur	.04
Silicon	.40
Manganese	1.75

It will be seen that here the total of the alloying impurities is not far different from that which is present in ordinary hematite pig. The phosphorus is high, but on the other hand the silicon is low. The latter point is, however, desirable in basic working for the following reason: To neutralize the silicon in working the charge a large quantity of limestone must be added, and in the basic open, hearth process the slag is necessarily much in excess of that of the acid process. This makes the working very difficult and, therefore the reduction of slag due to the lower silicon is a distinct advantage.

It would be interesting to follow the process of the elimination of the elements but this would lead into a metallurgical dissertation of some length, and we will content ourselves by giving a few particulars of the finished material which we gathered when we visited the Brymbo works.

At that time the chief product was "tin bars," i. e., bars for rolling down into sheets for tin plates. An inspection of the laboratory records showed the following analysis:

Phosphorus	.034
Sulphur	.029
Silicon	a trace
Carbon	.12
Manganese	.36

A steel of this composition gives a tensile strength of 23½ tons with an elongation of 35 to 38 per cent. in a test piece 8 in. long by 1½ in. diameter. This would be a dead soft material suitable for extreme deformation such as the deep stamping now so much used for solid tin ware of which we saw some remarkable specimens made with this steel at a latter date.

The Brymbo Company made 30,000 tons of tin bars annually, and their material bears a very high character. As an example of another description of steel, we give an analysis of a sample from a batch made for shipbuilding purposes:

Phosphorus	.03
Sulphur	.02
Silicon	.05
Carbon	.32
Manganese	.53

As we have already stated, the Admiralty and Lloyds' have tabooed basic steel in times past, but on this point they have recently given way. Lloyds have inspected certain works, mostly German, and admitted the basic steel produced by them, subject of course to the usual tests and inspection. What the Admiralty have settled is not yet definitely known, but at any rate certain works have been inspected by some of its high officials, and results could hardly have been otherwise than satisfactory.

For wire drawing, another extensive use to which the Brymbo steel is put, the following may be taken as an average composition.

Phosphorus	.035
Sulphur	.012
Silicon	.05
Carbon	.64
Manganese	.32

A wire .04 in. in diameter drawn from this steel showed a tensile strength of 83 tons per sq. in.

A still higher carbon steel is made for edge tools (agricultural), mining implements, etc. This will contain about .77 of carbon.

It will be seen from these facts that basic steel ranges over a wide field, from the dead soft material up to hard steel suitable for cutting edges; indeed, we have seen basic steel used for cutting tools in lakes. It is however, for the softer kinds that the basic process seems more particularly adapted, as exemplified by its large adoption for tin plates to be deep stamped or spun. The writer believes that in the United States the basic process has made little or no progress, and doubtless in the large deposits of splendid hematites America possesses, there has not been much temptation to leave the well-known acid process for unknown difficulties of the basic hearth. But there are vast iron producing areas in the United States where the nature of the ore (as in our own Cleveland district) would render the basic system especially applicable, and now that so many of those difficulties, inherent to the introduction of any new industrial process, have been overcome, it may at any rate be a question worth consideration by American ironmasters whether the basic process cannot be cultivated with advantage. For tin bars, as we have said, basic steel is peculiarly well adapted, and America is a great user of tin plates. We in Britain are quite contented with the present arrangements in regard to the industry, but American speculators might find it an interesting subject for investigation.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Utica & Unadilla Valley.—A correspondent has furnished us the following information concerning this road, which is projected to run from Bridgewater to New Berlin, N. Y., 20 miles:

The route of the road is along a river bottom, rising only 114 ft. in the entire 20 miles, and with very few curves. About one-half of the right of way has been secured and negotiations are nearly completed for the remainder. Local aid to the amount of $60,000, has also been obtained. W. H. Adams, of Bridgewater, N. Y., has the contract for completing the road. Six miles of the grading have been completed, and about 150 men are now at work on the line. It is expected that tracklaying will begin about Sept. 5, and the road be opened for traffic by Dec. 1. D. E. CULVER, 146 Broadway, New York, Chief Engineer, is in charge of construction.

Cleveland, Cincinnati, Chicago & St. Louis.—A report is in circulation that this company is negotiating for the lease or purchase of the Ohio, Indiana & Western R. R., running from Peoria, Ill., to Springfield, O., 342 miles.

Lehigh Valley.—The Newark & Roselle R. R. Co. has been incorporated in New Jersey in the interest of this company to build a line of railway between 6 and 7 miles long. The road will form a connecting link between the different routes of the Lehigh Valley R. R. in the through line scheme to New York.

Cooperstown & Charlotte Valley.—The extension from Cooperstown Junction to East Davenport, N. Y., will be opened for traffic soon. Efforts are being made by the citizens of Schoharie and Greene counties to have the road extended to Saugerties or Catskill. The distance from East Davenport to either place would be about 65 miles.

Cincinnati, Jackson & Mackinaw.—A meeting of the stockholders will be held Oct. 2, to vote on the proposition to construct the extensions from Addison to Jackson, Mich., and from Battle Creek to Lowell, Mich., also to vote upon the proposition to issue a mortgage of not more than $3,000,000, the money to be used in defraying the expenses of the proposed extensions, adding to the rolling stock, and making other improvements.

Rome, Watertown & Ogdensburg.—It is stated that this company has under consideration the building of several branches to connect its main line with Oak Orchard, Lakeside and Troutberg, N. Y.

Pennsylvania, Poughkeepsie & Boston.—Work on this road is being pushed rapidly to completion between the present terminus and Slatington, Pa., only 6 miles more of the road from Lehigh Gap to Slatington remaining to be graded.

York Harbor & Beach.—It is reported that this road will soon be extended from York Beach, Me., to Wells Beach, Me., to obtain a connection with the Boston & Maine R. R.

Coudersport & Port Allegheny.—This company proposes to build an extension from Coudersport to Ansonia, Pa., a distance of about 40 miles.

Beech Creek.—Surveys are being made for an extension from Gazzam to Oil City, Pa., where connection will be made with the Lake Shore & Michigan Southern R. R.

Rockaway Valley.—Two miles of the 4-mile extension from New Germantown to Pottersville, N. J., has been opened for traffic and tracklaying will soon begin on the remaining distance. The road will ultimately be built to Montclair, N. J., 26 miles from Pottersville. J. V. MELICK, of White House, N. J., is Chief Engineer.

Pennsylvania.—Work is being pushed on the Waverly & New York Bay R. R., which is to run from Waverly to New York Bay.

Evansville & Terre Haute.—It is reported that the MACKEY syndicate, which controls this road, will build a railway from Jasper, Ind., to Washington, Ind., a distance of 28 miles.

Kinderhook & Hudson.—Construction has commenced on this road at Hudson, N. Y. The road is to run from Hudson to Kinderhook, N. Y., a distance of 16 miles. E. G. FERRIS, of Hudson, is Chief Engineer.

West Shore.—Surveys are in progress, for a short line to connect Albany, N. Y., with Fuliers Station.

Somerset.—E. D. GRAVES, of Solon, Me., Chief Engineer, writes that the grading of the extension from Carratunk Falls to Bingham, a distance of 7¼ miles, is being rapidly pushed by S. C. MILLS, of Starks Me., who has the contract for building the road. Tracklaying will begin early in October. The construction of the 3-span iron bridge over the Kennebec river at Carratunk Falls will be commenced in about a week. The bridge is 400 ft. long. The Berlin Bridge Co. has the contract for building the structure. The route of the road passes through a fine farming and timber country and a large business in hard-wood timber, farm produce, and stone from the slate and granite quarries along the route is expected.

Projects and Surveys.

Northern Maine.—We have received the following information from FREDERIC DANFORTH, of Gardiner, Me., Chief Engineer:

The road is projected to run from Mattawamkeag to Presque Isle, Me., a distance of 114 miles. The preliminary survey has been completed for the entire line and locating surveys are now in progress. There will be only one bridge 100 ft. long in the entire distance. The route is through one of the finest timber and agricultural regions in the State. About one-fourth of the right of way has been obtained and $80,000 of other local aid secured. The contract for constructing the road will be let this fall. It is expected that the road will be opened for traffic by Jan. 1, 1891. The officers of the company are: GEO. P. WESCOTT, of Portland, President; G. H. FREEMAN, of Presque Isle, Me., Vice-President; and FREDERIC DANFORTH, Chief Engineer.

Philips & Rangeley.—A press dispatch states that negotiations have been concluded for the early construction of this road.

Vincennes, Oakland City & Owensboro.—At a meeting of the directors recently held the following officers were elected: President, EDWARD WATSON; Vice-President, J. C. HAINES; Secretary, C. W. BRANFORD, and Treasurer, J. W. A. OLIPHANT. It is stated that the road will be pushed through to completion at once.

Mount Moosilauke.—This railway company, which was incorporated under the last Legislature to build a railway up Mt. Moosilauke, N. H., is taking steps toward a permanent organization. Among the incorporators are: A. B. WOODWORTH, of Concord, N. H.; B. F. BROWN, of Franklin, N. H.; and EZRA B. MANN, of Woodsville, N. H.

Northern Maine.—The town of Hamilton, Me., has voted $7,500 in aid of this road. The road is projected to run from Presque Isle to Mattawamkeag, Me., 114 miles. GEO. B. WESCOTT, of Portland, Me., is President.

Montrose & Binghamton.—The engineers recently appointed by the Binghamton Board of Trade to make a survey looking forward to the construction of a railway from Montrose to Binghamton, N. Y., 30 miles, have submitted their report. The maximum grade will be about 125 ft. per mile, and there will be only one stream about 100 ft. wide to be bridged.

SOUTHERN.—Existing Roads.

Charleston, Cincinnati & Chicago.—McDonald, Shea & Co., of Memphis, Tenn., the contractors, have sublet about 50 miles of their contract and the remainder will be sublet at once.

Louisville & Nashville.—The new line from Pineville, Ky., to Middlesborough, the new town at Cumberland Gap, has been opened for traffic.

Atlantic Coast Line.—The Scotland Neck extension has been completed and opened for traffic to Greenville, N. C.

Darien Short Line.—The grading on this road is nearly completed and material is in transit from the north to complete the line. It is expected that trains will be running by Dec. 1. R. H. WALKER, of Darien, Ga., is President.

West Range.—Incorporated in Wisconsin to build a line of railway from a point on the Wisconsin Central R. R. in Ashland county to Bladder Lake, a distance of 7 miles. Among the incorporators are: J. J. FISH, S. A. COOK, and A. D. ELDRIDGE, of Neenah.

Farmville & Powhatan.—Work is being pushed on

this Virginia road. Chief Engineer H. A. WHITING is superintending the work of construction.

Columbus Southern.—This road is to be completed to Richmond, Ga., by Oct. 1.

Central R. R. of Georgia.—A large force of men are now at work on the lowlands west of the Ogeechee river grading the Eden extension. The long trestle across the Ogeechee river is rapidly approaching completion, and it is expected that construction trains will be running over it in a few days.

Ohio River.—The incorporators of the Ravenswood, Spencer & Glendale R. R. have made arrangements for the consolidation of this road with the Ohio River R. R. It is stated that construction will soon commence.

Gulf & Ship Island.—A force of men are now at work ballasting that portion of the road completed, and negotiations are now in progress for the early commencement of work on the remainder of the line. The road is projected to run from the Gulf of Mexico to Pontoto, Miss. W. H. HARDY, of Gulfport, Miss., is President.

Richmond & Danville.—Work on the Western North Carolina R. R. is being rapidly pushed. Tracklaying has been completed through the tunnel and is now being pushed toward Murphy, N. C.

Projects and Surveys.

Westmoreland County.—A project is on foot to build a line of railway from Fredericksburg, Va., to the bay through the northern neck of Virginia.

Knoxville Extension, Dahlonega & Augusta.—A bill is now before the Georgia Legislature to incorporate this company to build a railway from Blue Ridge to Dahlonega and thence to Gainesville and Augusta, Ga.

Georgia.—The following bills have passed the Georgia State Legislature, empowering the Darien Short Line to build a branch from Bosden's Bluff, and incorporating the Macon, La Grange & Birmingham, the Americus & Jacksonville, and the Georgia & Tennessee railway companies.

Nicholasville & Lancaster.—Incorporated in Kentucky to build a railway from Nicholasville to Lancaster, Ky. It is stated that surveys will begin at once.

NORTHWEST.—Existing Roads.

Port Arthur, Duluth & Western.—THOMAS MARKS, of Port Arthur, Ont., has sent us the following information:

The road is to run from Port Arthur, Ont., southwest via Fort William, Beaver Mine and Silver Mountain, a distance of 85 miles. The work is easy, and grades and curves are light. $25,000 local aid has been secured from Port Arthur and subsidies of $271,000 from the Dominion Government, and $150,000 from the Ontario Government have been obtained. About 50 miles of the line has been located. The contract has been let to G. H. Middleton and James Conmee, of Port Arthur. About 100 men are now at work on the line. It is expected that tracklaying will begin about Nov. 1, and 50 miles of the road be completed by July, 1890.

Duluth & Winnipeg.—A large force of men are now at work on the extension west of the Mississippi river, and it is stated that the number will be increased to 4,000 and the road completed within 90 days. The company has under consideration the building of a branch from the main line to the iron mines of Griffiths & Smith, in Itasca county.

Northern Pacific.—A report is in circulation that the Portage branch of the Northern Pacific & Manitoba will be extended under another name on a route parallel to the Manitoba & Northwestern R. R.

Kansas City, Wyandotte & Northwestern.—Tracklaying has begun on the Kansas City & Beatrice R. R. at the rate of 1 mile per day and the company expects to have trains running over the line within 3 months.

Paducah & St. Louis.—Surveys are in progress for a branch from Golconda, Ill., to New Grantsburg, a distance of about 17 miles.

Mobile & Ohio.—It is reported that this company will soon make surveys for a branch from Millstadt to Smithton, Ill.

Projects and Surveys.

Sioux Falls & Denver.—A press dispatch from Sioux Falls, Dak., states that contracts have been let and work will soon begin on this proposed road. Among the directors are G. H. DIXON, and I. H. DRAKE, of St. Paul, Minn.

Milwaukee, Bay View & Chicago.—Incorporated in Wisconsin to build a line of railway from Milwaukee, Wis., to Chicago, Ill. Among the incorporators are: FRANCES HINTON, GEO. D. VAN DYKE, and E. F. PRUSING, all of Milwaukee.

Perry, Pittsfield & Southern.—Articles have been filed incorporating a company to construct or acquire a line of railway from Perry, Ill., to Pittsfield and thence to a point on the Mississippi river opposite the city of Louisiana, with a branch line from Pittsfield to Nebo. Among the incorporators are: EDWARD F. BURNS, and GEO. BARBER, of Pittsfield, and GEO. W. WITHAM, of Perry.

SOUTHWEST.—Existing Roads.

Chicago, Rock Island & Pacific.—Tracklaying has been completed from Pond Creek to Skeleton, Indian Territory, 21 miles, and work is being pushed on the extension from Skeleton south to Kingfisher, 44 miles. Surveys are in progress from Kingfisher south 200 miles. The 1,100 ft. trestle across the Salt Fork of the Arkansas river, is completed with the exception of laying the guard rails, and the 1,824 ft. trestle across Cimarron river is about one-third completed.

Texarkana & Fort Smith.—A press dispatch states that about 100 teams are now at work on this road, and that 30 miles of the line will be completed within 6 months.

Kansas City, Fort Smith & Southern.—The engineers of this road are running a line from Sulphur to Bentonville, Ark. Work is reported begun on the line from Sulphur Springs to Splitlog, Ark.

San Antonio & Aransas Pass.—It is stated that a branch will be built from Altair to Columbus, Tex., by this company.

Red River, Sabine & Western.—A force of men are at work clearing the right of way between Palestine and New Birmingham, Tex., and grading will commence at once.

Denison & Washita Valley.—Construction has commenced at McAlester, Ind. Ter. A large amount of rails is on the ground and the contract has been let for 200,000 ties.

Omaha, Hutchinson & Gulf.—A press dispatch from Kingman, Kan., states that tracklaying on this road was completed to that city Aug. 29.

Projects and Surveys.

Yazoo Delta Central.—It is stated that work will soon commence on this road, which is projected to run from Yazoo City to Clarksdale, Miss., a distance of 60 miles, with branches from Clarksdale to a point on the Mississippi river or north to a point near Memphis, Tenn., and from Yazoo City to Vicksburg. Among the projectors are G. K. SMITH, J. Y. WALTON, and JOHN CLARK.

New Orleans & Northwestern.—The district attorney of Natchez, Miss., has commenced proceedings praying for the forfeiture of the charter of this company on the ground that no actual work has been done.

New Orleans, Natchez & Fort Scott.—It is stated that the contracts for building this road will be let soon and construction be commenced at once. The road is projected to run from New Orleans, La., to Fort Scott, Kan., a distance of 640 miles.

ROCKY MT. AND PACIFIC.—Existing Roads.

Ellensburg & Northeastern.—A press report states that about 80 teams are now at work on this Washington Territory road and about 10 miles of the grading has been completed. The road is projected to run from Ellensburg to Port Easton, W. T., 40 miles. U. C. LLOYD, of Ellensburg, is Secretary.

Pacific Short Line.—The surveys for this line have been completed from Ogden, Utah, east 140 miles and contracts will be let soon for building the road.

Seattle, Lake Shore & Eastern.—E. H. Warner, the contractor for clearing 15 miles of this line from the International boundary south has completed about two-thirds of the work. The country is nearly level and the work generally light. It is thought that rails will be laid this season.

Oregon Railway & Navigation Co.—W. H. KENNEDY, of Portland, Ore., Chief Engineer of the Washington & Idaho R. R., sends us the following information concerning the Mullan and Spokane branches of that road:

The Mullan branch of the Washington & Idaho R. R. runs from Tekoa, W. T., to Mullan, Idaho, via the Cœur d'Alene Indian reservation, a distance of about 87 miles, of which 85 miles are in Idaho. There will be an iron drawbridge of 224 ft. span across the St. Joseph river in Idaho. The principal business of the road will be in transporting ore from Cœur d'Alene mines. Kilpatrick Bros. & Collins, of Beatrice, Neb., have the contract for building the road. Nearly all of the grading has been completed and about 20 miles of track laid from Tekoa east. J. O. JANNISON, Division Engineer, of Tekoa, is in charge of construction.——The Spokane extension runs from Spokane Falls to Rockford, W. T., a distance of 26.7 miles. Grading is nearly completed and tracklaying will begin about Sept. 1. The road will be opened for traffic about Oct. 15. ROBERT MCCLELLAND, Principal Assistant Engineer, of Rockford, W. T., is in charge of construction.

Los Angeles, San Diego & Yuma.—A correspondent has sent us the following information:

This road is to run from Los Angeles south along the coast to San Diego, Cal., and thence east to Yuma, Ariz., a distance of 200 miles. About 8 miles of the road through the city of San Diego and along the water front has been completed. The greater portion of the line will be medium work with no very heavy grades and curves. The object of the road is to furnish terminal facilities for and to form with the Southern Pacific R. R. a direct line between San Diego and Galveston. A greater portion of the right of way has been secured. The contract for constructing the second section of the road will be let soon. The officers of the road are: WM. GRAVES, President; O. W. SANFORD, Chief Engineer; and F. H. DIXON, Secretary.

Union Pacific.—A report is in circulation that this company will soon consolidate the Colorado Central, the the Denver & Middle Park, the Denver, Marshall & Boulder, the Greeley, Salt Lake & Pacific, the Georgetown, Breckenridge & Leadville, and the Colorado Central of Wyoming railway companies into one corporate organization to be known as the Colorado Central R. R. Co.

Fairhaven & Southern.—This company has filed supplementary articles of incorporation with a capital stock of $6,000,000. The road is projected to run from the International boundary via Fairhaven, W. T., to the Oregon State line, a distance of 250 miles. J. J. DONOVAN, of Fairhaven, is Chief Engineer.

Deming, Sierra Madre & Pacific.—About 50 miles of this road from Deming, New Mexico, south has been completed, and it is expected that the Mexican boundary will be reached about Sept. 1.

Projects and Surveys.

Point Arena.—We have received the following information from Wells, Russell & Co., of San Francisco, Cal.:

The road is projected to run from Arena Cove to the north fork of the Garcia river, a distance of 10½ miles, with a branch from the crossing of Garcia river to the summit between the Garcia river and Brush creek, a distance of 1¼ miles. The grades and curves are light. There will be one important bridge across the Garcia river at Groshon's, 6½ miles from Arena Cove, with one 150-ft., and two 100 ft. spans, and 650 ft. of trestle work approaches. The total cost of constructing and equipping the road including the Brush creek branch is $138,412. The road is projected in the interest of Wells, Russell & Co., and will do a business principally in lumber and farm produce. It is expected that the right of way will be granted by the people along the route. JULIUS H. SMITH, 1520 Howard St., San Francisco, is Chief Engineer.

Silver City, Pinos Altos & Mongallon.—Incorporated in New Mexico to build a line of railway from Silver City to Pinos Altos, N. M. Among the incorporators are: W. H. NEWCOMB, H. H. BETTS, and JOHN MILLER, of Silver City.

Washington Hot Springs Co.—Incorporated in Washington Territory to build a line of railway from Washington Hot Springs to Franklin, W. T.

Midland Pacific.—A dispatch from Salmon City, Idaho, states that the engineers of this company have reached that place on their survey for the proposed line from Sioux City, Dak, to Puget Sound.

FOREIGN.

South America.—The first transcontinental railway in South America is approaching completion. When completed it will run from Buenos Ayres to Valparaiso. The portion now remaining to be built is the section crossing the Andes between Mendoza, in the Argentine Republic, and Santa Rosa, in Chili. The line will reach an altitude of 10,000 ft., and will pierce the summit with a tunnel 7 miles in length. The road will be completed with the exception of the tunnel in 1890. The tunnel will be completed about two years later, and until finished transportation over the summit will be effected by pack trains.

Zacualtipan.—A concession has been granted by the Mexican Government for the construction of a railway from Pachuca to Tampico, passing through the rich mineral districts of Apulco and Zacualtipan, with the right to build branches to various iron works along the line. The Government has granted a subsidy of $9,000 per mile. RICHARD HONEY is the concessionaire.

RAPID TRANSIT.

Electric Railways.—*Peabody, Mass.*—A franchise has been granted to the Essex Electric Ry. Co.

Troy, N. Y.—The Troy & Lansingburg Ry. Co. has opened its electric line.

Roanoke, Va.—The street railway has been sold to Capt. M. M. ROGERS, of Roanoke, and Mr. E. WATKINS, of Chattanooga, Tenn. They will put in an electric system.

Covington, Ky.—The street railway company is having surveys made for the new electric line.

Macon, Ga.—GEO. F. WORK, of Philadelphia, Pa., who has purchased the street railway will complete 10 miles of electric line in one year; the track will be relaid with 40-lb. rails.

Newark, O.—Mr. KIMBALL has made arrangements with the Sprague Electric Co. for the equipment of the Granville & Newark electric road.

Indianapolis, Ind.—A franchise for 20 years has been granted to the West Indianapolis Electric Ry. Co.

Green Bay, Wis.—The Thompson-Houston Electric Co. has applied for a franchise for an electric road.

Minneapolis, Minn.—The City Council has passed four ordinances for electric railways.

Cable Railway.—*Seattle, W. T.*—The North Seattle Cable Ry. Co., has been organized to build an extension of the Front St. line. It will cost about $140,000 and may be built by the company without letting contracts.

Street Railways.—*New York, N. Y.*—The Broadway line has been sold at auction to Col. D. S. LAMONT, representing the Philadelphia capitalists who are interested in the Broadway & 7th Ave. Ry. Co., for $25,000.

Altoona, Pa.—The Altoona City Passenger Ry. Co. has increased its capital stock to $35,000, and will extend its line to Millville and Belleview.

Beaver, Pa.—The Beaver Street Ry. Co. has been incorporated. Capital stock, $150,000.

Chicago, Ill.—The Chicago Suburban Street Ry. Co. has been incorporated by T. CLENDENNE, EDWARD E. HERBERT, and ANTHONY SCHILLER. Capital stock, $125,000.

Chippewa Falls, Wis.—A street railway company has been organized. T. E. POUND, DAVID E. MILES, and W. L. SEYMOUR are interested.

St. Thomas, Ont.—The street railway will be sold by auction Sept. 23 to satisfy a mortgage of about $3,500, held by the Southwestern Farmers' & Mechanics' Saving & Loan Society, if not disposed of by private sale in the meantime.

HIGHWAYS.

Georgia Roads.—Commissioner READ, of the road committee, Savannah, Ga., is in earnest in bettering the road system of the county, and in addition to the construction of the Waters road, 4 miles in length, and Estill Ave., 1 mile long, has pushed the repairs and grading on the Augusta and Ogeechee roads, putting in new culverts and bridges where needed, deepening the ditches, and in the work of road improvement has excavated some 40,000 cu. yds. of earth. This has been in addition to the extensive system of drainage of the county which has done so much for the city and county sanitation. With the teams soon to be provided for the department of road service much greater progress in road building will be made.

no cross country road to be awarded, and in fact the

Morris Ave., Springfield Township.

C. H. Lightipe ..	.87	.35	14,036.58	350	14,386.58
	10-in. 1.40				
T. A. Nevins.....	8-in. 1.25	.60	15,131.98	600	15,731.98
	6-in. .90				
B. Mahon.....	1.08	.30	17,424.72	300	17,724.72

Morris Ave., Summit Township.

T. A. Nevins	8-in. 1.25	.60	23,537.77	1,200	24,737.77
	3½-in. .40				
B. Mahon	.94	.30	29,468.06	600	30,068.06
C. H. Lightipe	.95	.35	29,781.55	700	30,481.55

Morris Ave., New Providence Township.

B. Mahon.....	1.10	.30	12,156.10	300	12,456.10
C. H. Lightipe....	1.15	.35	12,708.65	350	13,058.65
T. A. Nevins.....	1.25	.60	13,813.75	600	14,413.75

ing. R. T. Peppers, 8 cts. per cu. yd.; Thomas Nearney, 12¾ cts., and H. W. Crum & Co., 15½ cts.

South St. Paul, Minn.—The contract for improving Concord St. has been awarded to W. G. Mulligan, he being the lowest of 6 bidders. His bid was 11⅛ cts. per cu. yd. for earth, 36 cts. per cu. yd. for sandstone, and $1.30 for guttering.

Jails.—The contract for the new county jail at Ashland, Ore., has been awarded to the Pauly Jail Building & Mfg. Co., of St. Louis, Mo., at $5,000. The work includes a concrete floor, 3 steel-clad cage cells, corrugated iron ceiling and water tank.——The contract for the enlargement of the prison at Hudson, N. Y., has been awarded to Fitzgerald & Co., of that city, for $25,000.

Dredging.—The following proposals were opened Aug. 28 by Gen. S. T. ABERT, U. S. Engineer Office, Washington, D. C.: In Pamunky river, Va.; American Dredging Co., Philadelphia, 19 cts. per cu. yd.; T. P. Morgan, Washington, 25 cts. In Rappahannock river, Va.; American Dredging Co., 19 cts. In Patuxent river, Md., T. P. Morgan, 20 cts.

Highways.—The following proposals for constructing highways or roads and their appurtenances at East Branch and Bog Brook reservoirs, were received by the Aqueduct Commissioners, New York City, Aug. 21.

Items.	Quantities.	Clinton Stephens.		Rider & Dougherty.		Breauchaud, Pennell & Co.		John J. Ridgway.		J. B. Byron.		Smith & Brown		Canning & Levy.		Engineer's Estimate.	
		Price	Amount.	Price	Amount.	Price	Amount.	Price	Amount.	Price	Amount.	Price	Amount.	Price	Amount.	Price	Amount.
Earth excavation	50,000 cu. yds.	$ .29	$14,500	$ .25	$12,500	$ .27	$13,500	$ .24	$12,000	$ .20	$10,000.00	$ .25	$12,500	$ .25	$12,500	$ .35	$17,500.00
Rock excavation	3,500 "	1.00	3,500	1.10	3,850	1.20	4,200	1.00	3,500	.90	3,150.00	1.50	5,250	1.50	5,250	1.75	6,125.00
Rip-rap	5,000 "	1.50	7,500	.80	4,000	1.25	6,250	1.50	7,500	1.25	6,250.00	2.00	10,000	2.00	10,000	1.50	7,500.00
Rubble stone masonry	500 "	5.00	2,500	4.25	2,125	5.00	2,500	4.00	2,000	4.40	2,220.00	4.00	2,000	4.25	2,125	5.00	2,500.00
Dry rubble stone masonry	500 "	4.00	2,000	3.00	1,500	4.00	2,000	3.00	1,500	2.80	1,400.00	3.50	1,750	2.50	1,250	3.00	1,500.00
Split stone masonry	150 "	6.00	900	3.50	525	7.50	1,125	4.50	675	6.00	900.00	8.00	1,200	3.00	450	7.00	1,050.00
Dimension stone masonry	50 "	12.00	600	18.00	900	25.00	1,250	20.00	1,000	10.60	530.00	35.00	1,750	30.00	1,500	12.00	900.00
Brick masonry	200 "	13.00	2,600	12.50	2,500	12.50	2,500	12.00	2,400	12.00	2,400.00	14.00	2,800	10.00	2,000	9.50	1,900.00
Concrete masonry, 5 to 1	50 "	6.00	300	5.00	250	4.50	225	5.00	250	4.25	212.50	4.50	225	5.50	275	5.00	250.00
Add'l for masonry in Portland cement	50 "	1.50	75	1.50	75	1.00	50	1.50	75	.75	37.50	2.50	125	1.50	75	1.25	62.50
Fine hammer (6 cut) face dressing	100 sq. ft.	.50	50	.65	65	.75	75	.75	75	.73	73.00	.75	75	.80	80	.75	75.00
Rough point face dressing	200 "	.40	80	.50	100	.40	80	.45	90	.29	58.00	.50	100	.45	90	.35	70.00
Face work for rubble stone masonry	1,000 "	.40	400	.70	700	.40	400	.45	450	.37	370.00	.50	500	.35	350	.25	250.00
White pine timber	5,000 ft. B. M.	50.00	250	40.00	200	40.00	200	45.00	225	60.00	300.00	50.00	250	50 00	250	30 00	150.00
White oak timber	4,000 "	50.00	200	50.00	200	50.00	200	50.00	200	60.00	240.00	50.00	200	75.00	300	40.00	160.00
Hemlock timber	5,000 "	30.00	150	27.00	135	30.00	150	30.00	150	35.00	175.00	35.00	175	30.00	150	25.00	125.00
15-in. tile drain pipe	300 lin. ft.	1.50	450	1.00	300	.75	225	1.50	450	.72	216.00	.60	180	1.25	375	1.50	450.00
Stonewall fencing	73,000 "	.70	51,100	.80	58,400	.75	54,750	.80	58,400	.93	67,890.00	.85	62,050	1.08	78,840	.75	54,750.00
Post and rail fencing	3,300 "	.12	396	.30	990	.40	1,320	.25	825	.20	660.00	.30	990	.70	2,310	.20	660.00
Totals			$87,551		$89,315		$91,000		$91,765		$97,062.60		$101,790		$118,170		$95,977.50

Fanwood and Westfield township line are the same. The canal only had $150,000 to spend at present; of this amount St. George's Ave. will take about $43,000; Union township of Morris Ave. $55,000; Fanwood township of North and South Ave., $16,000; Westfield township of North and South Ave., $22,000; total, about $133,000. This leaves a balance of about $13,000 or $14,000 to be spent on Cranford township, which Fadham & Weldon will get for as much as can be done with it. The following are the details of the several bids, as furnished by Mr. DUNHAM:

New Jersey Roads.—Mr. F. A. DUNHAM, Engineer and Superintendent of County Roads, Plainfield, N. J., writes to correct the particulars given last week of the contracts for roads awarded by the Freeholders of Union County, N. J., at Elizabeth. They only awarded them for building one road complete and part of two others. There were only three roads to be built, as follows: St. George's Ave. in 2 sections, Morris Ave. in 4 sections, North and South Ave. in 4 sections. St. George's Ave. in 2 sections was awarded to B. M. & J. F. Shanley for about $43,000, and 1 township (Union) in Morris Ave. was awarded to B. Mahon for about $55,000. Mahon did not get the contract for the road from Elizabeth to Plainfield, but only one township (Westfield) for $22,196.42. Fanwood township went to H. G. Wood for $16,208,10. There was

St. George's Ave., Linden Township.

	Sq. yd. pavement	Cu. yd. excavat'n	Cost pavement	Cost excavation	Cost total
			$	$	$
Shanley	1.12	.30	32,856.32	2,100	34,956.32
B. Mahon	1.18	.60	34,616.48	4,200	38,816.48

St. George's Ave., City of Rahway.

Shanley	.98	.25	7,626.36	125	7,751.36
	12-in. .16	....	5,568.00		
	8-in. .89	....	2,657.54		
Fordham & Weldon	.....	.30	8,225.54	150	8,375.54
	12-in. 1.15	....	5,520.00		
Wm. Chamberlain	8-in. .94	....	2,806.84		
		.30		150	8,476.84
B. Mahon	1.15	.30	8,949.30	150	9,099.30

Morris Ave., Union Township.

B. Mahon	1.18	.18	52,958.40	2,700	55,658.40
C. H. Lightipe	1.17	.35	52 509.60	5,250	57,760.60

North and South Aves., Fanwood Township.

H. G. Wood	.90	.30	14,408.10	1,800	16,208.10
B. Mahon	1.08	.45	17,289.72	2,700	19,989.72

North and South Aves., Westfield Township.

B. Mahon	.98	.40	21,294.42	900	22,194.42
H. G. Wood	1.10	.30	23,901.90	675	24,576.90

North and South Aves., Cranford Township.

	12-in. 1.15	....	5,315.55		
	10-in. 1.03	....	2,746.66		
	8-in. .87	....	3,290.37		
	6-in. .67	....	2,363.10		
	3½ in. .40	....	2,488.89		
Fordham & Weldon	.....	.32	16,074.57	640	16,714.57
H. G. Wood	1.05	.30	21,667.80	600	22,267.80
B. Mahon	1 10	.40	22,690.60	800	23,490.60

North and South Aves., Union Township.

	12-in. 1.17	....	7,677.13		
	10-in. 1.03	....	8,188.73		
	6-in. .64	....	1,459.12		
Fordham & Weldon	.....	.33	27,324.98	2,310	29,634.98
H. G. Wood	1.12	.30	28,405.44	2,100	30,505.44
B. Mahon	1.12	.40	28,405.44	2,800	31,205.44

CONTRACTING.

Water-Works.—Particular attention is called to the date of opening the bids for the water-works at Marietta, O., which should be Tuesday, Sept. 24, instead of Sept. 12, as in previous advertisement.

Street Work.—*Newark, N. J.*—The Street Committee has awarded the contract for trap-rock paving on Arch St. to B. M. & J. F. Shanley at $1.99 per sq. yd., and for cobble stone paving on Vesey St. to Conway & McManus at 85 cts.

Olneyville, R. I.—The contract for grading and curbing the old Killingly road at Manton has been awarded to Roscoe A. Woodbury, of Pawtucket, at the following prices: excavating, 30 cts. per cu. yd.; sand filling under curbing and paving, 35 cts. per cu. yd.; curbing, 60 per lin. ft.; setting curbing, 7 cts. per lin. ft.; quarter rounds, corner curbing, 3 ft. in length, 87 cts. per ft., and for setting, 11 cts. per ft.; cobble paving, 46 cts. per sq. yd. The contract amounts to $7,219.32.

Kansas City, Kas.—The following contracts have been awarded: cedar block paving, John O'Leary, $1.34 per sq. yd.; curbing, Ulrich Bros., 42½ cts. per lin. ft.; grading, R. T. Peppers, 8 cts. per cu. yd.; Thomas Nearney, 12¾ cts., and H. W. Crum & Co., 15½ cts.

Cruisers.—The following bids have been received by the Navy Department, Washington, D. C., for 3 cruisers of 2,000 tons, to cost not more than $700,000 each, and 2 cruisers of 3,000 tons, to cost not more than $1,100,000 each. The Bath Iron Works, of Maine, proposed to build the 2,000 ton vessels for $780,000 each, but with the addition of 6 months to the advertised time of 2 years; Cramp & Son, of Philadelphia, proposed to build the same vessels at $875,000 each, and the 3,000 ton vessels at $1,225,000 each. The bids were necessarily rejected and new advertisements have been issued.

Timber and Rope.—The following proposals for material for the Congressional library building have been received by BERNARD R. GREEN, Engineer and Superintendent, Washington, D. C. For derrick spars and square timbers: H. M. Harriman, Baltimore, Md., $3,268 89 (awarded contract); Libbey, Bittinger & Miller, Washington, D. C., $4,459; F. B. Brooks, Chester, Pa., $2,400.50, for derrick spars only. For rope: E. G. Wheeler, Washington, 13.2 cts. per lb. for manilla rope, 13.2 cts. per lb. for marlin; C. W. Johnson, Washington, 13¾ cts., 11 cts.; James B. Lambie, Washington, 13 cts., 12 cts.; Uhler & English, Philadelphia, 13.2 cts., 12 cts.; Johnson Bros., Baltimore, 13½ cts., 11 cts.; Rowland A. Robbins, New York, 12.9 cts., 12.9 cts.; Loud, Claridge & Co., Baltimore, 13.75 cts., 12.4 cts.; Wm. Wall's Sons, New York, 12.50 cts., 10 cts. (awarded contract).

New Croton Aqueduct.—On recommendation of Mr. GEO. S. RICE, Deputy Chief Engineer, the Aqueduct Commissioners have awarded the following contracts: For walls, foundations, and filling near the blow-off chamber at the Harlem river, being work not contemplated in the original contract, awarded to Charles Peterson, the present contractor for Section No. 12, at $4.50 per cu. yd. for rubble stone masonry laid in mortar, $3.50 for dry rubble masonry, 75 cts. for foundation filling. For grouting in the vicinity of both ends of the iron-lined masonry aqueduct in the vicinity of Shaft 30 and also in some parts of the iron-lined section; awarded to Breauchaud, Pennell & Co., contractors for this part of the work, at $2.50 per day for drillers, $2.50 for other labor, $1.50 per bbl. for approved American cement, 25 cts. per bbl. for sand.

Sewers.—*Hartford, Conn.*—The following proposals have been received by C. H. BUNCE, City Surveyor, for the Amity St. sewer: Thos. S. Reardon (awarded contract), $1.69 per ft. for sewer, $27 for plank, $35 for manholes, $2,563.35; Sylvester Bissell, $1.79, $22, $35, $2,610.38 Michael O'Neil, $1.93, $24, $45, $2,843.46; Jos. Prendergast, $2.10, $25, $35, $3,056.75.

Cincinnati, O.—The following proposals for the Lick Run sewer have been received by the Board of Public Works: The bids are for the sewer from a point 2,200 ft.

west of Harrison Ave. to South Branch, Geo. H. Meyer, $101,224; Henry McErlane, $68,615; M. Peter & Son, $68,125.50; Henry Frank, $67,858; Dennis Flaherty, $64,444; Henkel & Brehm, $64,400; Daniel F. Minahan, $64,110; Folz & Jonte, $59,809; P. Murray & Sons, $57,679; Wm. C. Murray, $55,294; A. B. Ashman, $54,525; B. D. Barton, $48,167.60.

From Harrison Ave. to a point 2,200 ft. west of Harrison Ave., R. G. Huston, $132,630; Geo. H. Meyer, $131,499; D. F. Minahan, $111,730; Henry Frank, $107,005; Dennis Flaherty, $104,949; W. C. Murray, $104,836; M. Peter & Son, $104,042; P. Murray & Sons, $99,559; Henkel & Brehm, $96,830; Folz & Jonte, $92,884; Henry McErlane, $90,315; A. B. Ashman, $88,356; B. D. Barton, $80,088.

Sewer Pipe.—The District Commissioners, Washington, D. C., have awarded contracts as follows: American Sewer Pipe Co., $4,323.50; Somerville & Sons, $4,020; A. Lamond, $2,585; Globe Sewer Pipe Co., $8,203.87.

Dredging.—The following proposals for dredging in the Hudson river have been received by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.: For 15,000 cu. yds. at Troy; P. W. Myers, 27 cts. per cu. yd. (awarded contract); J. H. Fenner, Jersey City, N. J., 28½ cts.; P. J. Brumelkamp, Syracuse, 40 cts. For 9,000 cu. yds. at Cuyler's light; J. H. Fenner, 11½ cts. (awarded contract); P. J. Brumelkamp, 13 cts.; Jacob Holler, 13 cts.; E. M. Payn, 14 8-9 cts. For 8,000 cu. yds. at Troy; J. H. Fenner, 18 cts. (awarded contract); E. M. Payn, 19 cts.; P. W. Myers, 24 cts.; P. J. Brumelkamp, 24 cts. For 7,000 cu. yds. at Bogart's light; J. H. Fenner, 10½ cts. (awarded contract); P. J. Brumelkamp, 12 cts.; Jacob Holler, 13 cts.; E. M. Payn, 13⅝ cts.

Street Work.—*West Troy, N. Y.*—The following proposals have been received by the Paving Commission for 29,349 sq. yds. of granite pavement, 7,176 sq. ft. of blue stone bridge stone, and 12,330 lin. ft. of blue stone curbing. The contract was awarded to Henry Dumary, of Albany.

	Pavement	Bridge stone	Curb
		cts.	cts.
Henry Dumary, Albany, N. Y.	$2.40	40	60
Haskins & Culver, New York	2.52	57	79
McCann & Flagler, Troy, N. Y.	2.65	40	60
Holler & Larkin, Albany, N. Y.	2.57	43	78
Malone & McKenna, Troy, N. Y.	2.63	40	75
Thos. Riley, Albany, N. Y.	2.63	35	80
Chas. Guidet, New York	2.76	72	80
Doyle & Hildreth, Cohoes, N. Y.	2.98	44	60
Cavanaugh & Paynton, Troy, N. Y.	2.90	60	90
John McDonald, Troy, N. Y.	3.09	35	72

PROPOSALS OPEN.

Water-Works.—Cast-iron pipe and a stand pipe 12 ft. diameter and 110 ft. high. J. D. HAMILTON, City Clerk, Geneva, Neb. Sept. 10.

Sewers.—Terra-cotta pipe sewers, concrete sewers, brick sewers, and receiving basins. THE DISTRICT COMMISSIONERS, Washington, D. C. Sept. 11.

Sewers and Street Work.—Outlet sewers and branches. Regulating, grading, curbing, and granite block paving. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. Sept. 11.

Cross Ties.—For 30,000 pine ties, 25,000 tamarac, and 15,000 oak; 70,000 in all. No bids for less than 15,000. Delivery to be completed by May, 1890. M. J. CARPENTER, Vice-President, Duluth & Iron Range R. R. Co., Duluth, Minn. Sept. 14.

Dredging.—About 25,000 cu. yds. at the pier at foot of W. 39th St. and adjoining bulkheads on North river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. Sept. 16.

Water Works.—At Seward, Neb. To cost about $30,000. For specifications, etc., apply to the City Clerk, or to A. A. RICHARDSON, Consulting Engineer. THE CITY CLERK, Seward, Neb. Sept. 16.

Excavation.—All the labor and materials required for the trench excavation, concrete foundations and stone and brick work of the U. S. post office building at Lancaster, Pa. H. WINDRIM, Supervising Architect, Treasury Department, Washington, D. C. Sept. 17.

Lighthouses.—Metal work and completion of the metal work of the Gulf shoal and Pamlico lighthouses, North Carolina. Capt. J. C. MALLERY, U. S. Lighthouse Engineer, Baltimore, Md. Sept. 18.

Roads and Walks.—Capt. GEO. E. POND, Asst. Q. M., U. S. A., Fort Riley, Kan. Sept. 20.

Sewers.—Complete system of sewerage. D. C. SMITH, Houston, Tex. Sept. 23.

Boilers.—Two new boilers for boiler-house of Franklin county court-house; and excavation, stone masonry and brick work necessary for setting same. FRANK J. REINHARD, County Auditor, Columbus, O. Sept. 26.

MANUFACTURING AND TECHNICAL.

Market Prices.—*Rails.*—New York and the East: $28 to $28.50. Pittsburg: $30 for heavy sections on cars at works. Chicago: $32 to $32.50 for standard sections, $35 for 30 to 35 lb. Old rails: $24.25 to $24.75 for iron, $15 to $18 for steel, at Chicago.

Track Material.—New York: splice bars, 1.85 cts. to 1.90 cts. delivered; spikes, 1.95 cts. to 2 cts. Pittsburg: spikes, 2.10 cts., 30 days, on cars: splice bars, 1.75 cts. to 1.85 cts.; track bolts, 2.75 cts. to 2.85 cts. Chicago: steel splice bars, 1.90 cts. to 1.95 cts.; iron splice bars, 1.80 cts., to 1.85 cts.; spikes, 1.95 cts. to 2 cts.; bolts, square nuts 2.50 cts. to 2.55 cts.; hexagon, 2.60 cts. to 2.65 cts.

Structural Iron.—New York: prices on dock; sheared plates, 2.15 cts.; universal mill plates, 2.20 cts. to 2.25 cts.; angles, for the smaller sizes, 2 cts. to 2.10 cts.; for larger sizes, 2.25 cts.; tees, 2.4 cts. to 2.6 cts.; beams and channels, 2.8 cts. In plates, steel tank is 2.3 cts. to 2.35 cts. for ¼-in. or thicker, and 2.45 cts. to 2.5 cts. for thinner; shell, 2.55 cts. to 2.6 cts.; flange, 2.75 cts. to 2.8 cts., marine steel, 2.8 cts. to 2.85 cts.; fire-box, 3.25 cts. to 3.75 cts.; bars, common 1.6 cts. to 1.65 cts.; medium, 1.65 cts. to 1.7 cts. and refined 1.8 cts. to 2 cts.; hoops, 2 cts. to 2.1 cts.; galvanized sheets, 65 & 5 %. Chicago; prices f. o. b.; angles, 2.25 cts. to 2.35 cts.; universal plates, 2.30 cts. to 2.40 cts.; sheared plates, 2.35 cts. to 2.40 cts.; tees, 2.60 cts.; beams and channels, 2.90 cts. From stock on hand; angles, 2.40 cts.; tees, 2.65 cts. to 2.70 cts.; beams and channels, 3.40 cts.

Car Wheels.—The Centennial Rolled Steel Car Wheel Co., of Norristown, Pa., has, after considerable experiment, developed a machine for rolling wheels from steel blanks. The company proposes now to establish a plant with a capacity of 100 wheels a day. The wheels will be made from either Bessemer or open-hearth steel, manufactured at Norristown.

A Powerful Engine.—E. P. Allis & Co., of Milwaukee, Wis., have erected a Reynolds-Corliss quadruple expansion engine of 2,500 H. P. for the Warren Mfg. Co., of Warren, R. I. The cylinders are 24, 36, 52½, and 64½ ins. diameter, 72 ins. stroke. The fly-wheel is 32 ft. diameter, with grooves on the rim for 43 driving ropes.

Coke Burning Locomotives.—The Baltimore & Ohio has had the fire boxes of some of its engines altered for burning coke, so as to avoid the annoyance of cinders on the passenger trains. These engines are giving very good performance.

Cincinnati, O.—The following proposals have been received by the Board of Public Works for the bridge at Colerain Ave. The bids for the superstructure were as follows: Mt. Vernon Bridge Co., Mt. Vernon, O., $19,600 with steel joists, $15,750, with wooden joists, 4 cts. per lb. for increase or decrease in iron; Smith Bridge Co., Toledo, O., $21,900, $16,750, 3½ cts.; Milwaukee Bridge Co., Milwaukee, Wis., $22,117.50, $15,944, 3.9 cts.; Variety Iron Works, Cleveland, O., $23,000.50, $19,900, 3½ cts.; F. J. P. Brackett, Cincinnati, $24,200, $20,900, 4.2 cts. The bids of the substructure were as follows (P. J. Slattery's bid was laid over and not opened):

	Old wooden superstructure	3,300 cu. yds. excavation	13,500 ft. piling	57,000 ft. B. M. timber	360 cu. yds. concrete	2,600 cu. yds. stone (Indiana)	2,500 cu. yds. stone (Hill)	Total with Indiana stone	Total with Hill stone
J. W. Gaffney	$30	$0.24	$0.35	$30.00	$5.00	$8.00	$7.00	$28,947.00	$26,447.00
Folz & Jonte	50	1.00	.29	1.00	2.50	7.55	6.00	20,972.00	23,097.00
Michael Stoffer	360	.70	.32	22.50	4.35	8.55	7.50	29,065.00	26,440.00
Hinkley & Brehm	250	.95	.24	25.00	3.00	9.87	8.87	30,965.00	28,465.00
P. Murray & Son	10	.75	.25	21.00	3.75	7.90	7.00	28,099.50	25,849.50
P. E. Scully	10	.60	.28	28.00	4.25	8.60	8.40	30,353.50	29,883.50
Shipman & Richardson	50	.50	.25	25.00	4.00	8.25	7.85	28,695.00	27,695.00
N. Ruebel	400	.50	.25	25.00	4.50	9.25	8.50	30,750.00	28,875.00
John Sperry	50	.65	.28	24.00	5.50	9.50	8.00	32,918.00	29,168.00
Dennis Flaherty	1	.90	.21	28.00	5.50	9.00	8.50	31,825.00	30,575.00

Sisal Hemp.—E. R. VAN BUREN, General Manager of the Industrial Machine Works, Jacksonville, Fla., writes us that he has in successful operation a machine for cleaning sisal hemp or hennequen.

Spiral Pipe.—The Abendroth & Root Mfg. Co., of New York, has been awarded a contract for 12 miles of spiral riveted pipe, to be used on the works of the Nicaragua canal. This is said to be the largest order of the kind ever given in this country.

Locomotives.—The Rhode Island Locomotive Works, of Providence, R. I., have an order for 2 passenger engines, with 16-in. cylinders and 50-in. drivers, for the Empire & Dublin. They are also building 2 eight-wheel engines for the East & West Alabama, and 12 consolidation engines for the Fitchburg.

The Rogers Locomotive Works, of Paterson, N. J., have an order for 6 freight engines for the Sioux City & Northern.

Cars.—The St. Charles Car Co., of St. Charles, Mo., has an order for 25 caboose cars for the Mexican Central.

The Haskell & Barker Car Co., of Michigan City, Ind., has orders for 100 box, 100 flat, and 100 stock cars for the Sioux City & Northern.

The Lafayette Car Works, of Lafayette, Ind., have an order from the Toledo, Ann Arbor & North Michigan for 100 box cars and 100 gondola cars.

The Pennsylvania Railroad Co. has let contracts as follows for freight cars for the lines west of Pittsburg: Pullman Palace Car Co., Chicago, 500 box cars and 500 drop-bottom gondola cars; Michigan Car Co., Detroit, 500 box cars and 250 gondolas; Ohio Falls Car Co., Jeffersonville, Ind., 500 box cars; Lafayette Car Works, Lafayette, Ind., 500 box cars; U. S. Rolling Stock Co., 250 gondolas.

Plant Wanted.—Pumps for water supply. J. A. Dodson, Superintendent of the Georgia, Carolina & Northern Ry., Monroe, N. C.

Second-hand portable boiler of 16 H. P. W. Kennedy, Moscow, Tex.

Second-hand portable or stationary engine of 8 to 12 H. P. J. C. Boyd, Pittsburg, Tex.

Condensing System for Pumping Engines.—The Gordon Steam Pump Co., of Hamilton, O., has purchased a right to use John W. Hill's improved system of condensation for pumping engines, with its machinery; and negotiations are now pending with the Holly Mfg. Co., of Lockport, N. Y., for the purchase of a similar license. Both of these companies have built and used the system and recognize its merits.

The Smith Bridge Co., of Ohio, has filed articles of incorporation at Austin, Tex. Capital stock, $60,000.

Cement.—The Cedar Cliff Cement Co., of Cedar Cliff, Mineral county, W. Va., has been organized by JOHN C. BRADLEY, of Cedar Cliff, W. Va., and THOS. S. KEAN JOHN KEATING, L. M. SHEPHERD, J. W. THOMAS, of Cumberland, Md. Capital stock, $100,000.

BRIDGES AND CANALS.

Canals.—*Gothenburg.*—The contract for the Gothenburg canal in Nebraska, has been awarded to McDonald, Penfield & Co., of Fremont, Neb. The work comprises about 310,000 cu. yds. and is to be completed by December. Cox & Elliot, of Kearney, Neb., are the engineers.

Chesapeake & Ohio.—A meeting of delegates from counties bordering on the canal will be held at Hagerstown, Md., Sept. 10, to consider the restoration of the canal.

Florida.—The Fernandina, Jacksonville & St. Augustine Ship Canal & Transportation Co. has been organized at Fernandina by M. B. BARTHOLOMEW, J. E. T. BOWDEN, and others, to construct a ship canal.—It is proposed to organize a company to open up the Oklawaha river to navigation by cutting canals to the river.

Viaduct.—*East St. Louis, Ill.*—The contract for the viaduct over the railway tracks at Broadway and 3rd St. has been awarded to the Missouri Valley Bridge Co., of Leavenworth, Kan.

Bridge Notes.—*Augusta, Me.*—The city government has voted $60,000 for the construction of an iron bridge across the Kennebec to replace the old one.

Indian Castle, N. Y.—The Groton Bridge & Mfg. Co., of Groton, N. Y., has the contract for 4 new iron bridges at this place.

Pittsburg, Pa.—The Homestead Bridge Co. has been incorporated. Capital stock, $30,000. The company proposes the building of a bridge over the Monongahela river at the foot of Ann St. PERRY BROWN, E. M. O'NEILL, CHARLES E. SPEER, W. W. BRADFIELD, and JAMES F. KUHN, are the stockholders.

Allegheny, Pa.—The South 22d St. Bridge Co. has been organized by JOHN F. STEEL, R. S. FRAZER, WM. J. SMITH, A. M. NEEPER, and ALEXANDER GILFILLAN to erect a bridge over the Monongahela river from Brady St., to South 22d St., Pittsburg. The structure will probably be used by one of the new street car lines.

Baltimore, Md.—The contract for the superstructure of the Cedar Ave. bridge has been awarded to the King Iron Bridge & Mfg. Co., of Cleveland, O., whose bid was $30,000, or $774 less than the next lowest bid, which was made by the Pencoyd Iron Works, of Philadelphia.

Wheeling, W. Va.—The County Commissioners will build an iron bridge of 70 ft. span across Wood's run.

Jackson, Miss.—The contract for the iron bridge over the Pearl river has been awarded to the King Iron Bridge & Mfg. Co., of Cleveland, O., at $13,000.

St. Louis, Mo.—There are now 3 piers of the Merchant's bridge nearly finished, and the first span will be raised by the middle of November. Work is progressing rapidly and the bridge may be completed by February or March. It is expected to open the bridge for traffic by April 1, 1890.

Kansas City, Mo.—The Missouri River Land Improvement & Construction Co., which has charters for 2 new railways, will build a 4-track steel bridge over the Missouri river. The company has a franchise from Kansas City, Kan.

Lawrence, Kan.—The County Commissioners have authorized the construction of 5 new bridges to replace those washed out by the recent floods.

Jefferson, Tex.—The following proposals for the Polk St. bridge over the bayou, were opened by the County Commissioners on Aug. 27: Geo. E. Knight Bridge Co., $5,050; Kansas City Bridge & Iron Co., $6,398; Missouri Valley Bridge & Iron Works, $6,770; Kelly Iron Bridge Co., $6,725; Smith Bridge Co., Toledo, O., $6,830; Penn. Bridge Co., $5,960; Berlin Iron Bridge Co., East Berlin, Conn., $6,530. The contract was awarded to the Geo. E. Knight Bridge Co.

La Crosse, Wis.—Maj. MCKENZIE, government engineer, has accepted the plans for a bridge at La Crosse. They provide for a 300 ft. span, and a draw span swinging 200 ft. clear on either side.

ELECTRICAL.

Electric Lighting.—***Amherst, Mass.***—The Amherst Gas Co. and the Amherst Electric Light Co. will probably be consolidated.

Mystic, Conn.—The Boston Electric Light & Gas Co. has purchased the charter obtained from the Legislature, and has signed a contract to illuminate the village of Mystic Bridge. The contract calls for the lighting of the streets and residences before Dec. 1. Probably both electric and gas lights will be introduced.

Rockville, Conn.—The Rockville Gas Co. will put in a Thomson-Houston electric plant this fall.

Greenbush, N. Y.—The Village Trustees have contracted with the East Albany Gas Co. for 60 arc lights of 1,200 c. p. at 20 cts. per light per night and 175 incandescent lights of 25 c. p. at 5½ cts.

Bangor, Pa.—There is talk of a company erecting an electric light plant to supply Bangor, East Bangor, and Pen Argyl with electric light, and of constructing an electric road between here and Pen Argyl. The investment would amount to over $200,000.

Allegheny, Pa.—The Gas Committee has decided to accept one or other of the bids offering to sell a plant to the city.

Bridgewater, Va.—An electric light company has been organized, with $15,000 capital stock. President, F. A. WYMAN; Treasurer, A. S. PALFREY.

Franklin, Tenn.—The Franklin Electric Light & Power Co. has been organized. Capital stock, $6,000. A plant of 20 arc and 200 incandescent lights is wanted. For particulars address Reville & Jounal.

Rome, Ga.—The city wants bids for electric lighting. Address JOHN C. PRINTUP, Chairman of the Gas Committee.

Ottawa, Ill.—A citizens' coöperative electric light company is proposed, citizens to subscribe for stock, to use the light themselves, and to let the city have 90 or 100 arc lights at a fraction above cost, say $50 per lamp on the basis that the cost of furnishing one lamp would be $40. The Council may invite proposals for a city plant.

Pana, Ill.—The City Council has made a contract with the Springside Coal Mining Co. for 100 incandescent lights of 25 c. p. at $1,700 per annum.

East St. Louis, Ill.—The Citizens Electric Light & Power Co. has been incorporated by H. D. SEXTON, STEPHEN SEXTON and ANTONY ISCH. Capital stock $25,000.

Oshkosh, Wis.—There are now 150 lights of 1,200 c. p. each, and it is proposed that the city establish a plant of its own with 225 lights.

Red Oak, Ia.—The proposition to issue $10,000 for an electric light plant has been voted down, and a franchise will probably be granted to a company.

Mankato, Minn.—The gas and electric light company proposes to supply the city with 35 arc lights at $8 per month, and 75 incandescent and gas lights at $2 each per month. This is to include a five years lease. The lights are to run to 12.30 and to be run upon the Philadelphia schedule. The total cost of these lights would be $430 per month or $5,100 per year.

St. Louis, Mo.—Chas. A. Brown has transferred his contract for lighting the northern part of the city by electricity for 10 years to the Laclede Gas Co.

Kansas City, Kan.—The Consolidated Electric Light Co. has offered to furnish the city with incandescent light at the points where gas lamps are now being used for a consideration of $20 per year.

Blair, Neb.—The Electric Light & Power Co. has been incorporated by EDWARD W. KENNY, S. P. HOWE, and F. M. CASSETT. Capital stock, $300,000.

Berkeley, Cal.—The Alameda Water Co. has applied for a franchise for an incandescent electric light system

Barrie, Ont.—The Barrie Electric Light Co., now operating a Ball arc light system, has purchased of A. J. Lawson, Montreal, a 600 light Brush alternating current incandescent plant which is to be subsequently increased to 1,000 lights capacity. The dynamo is to be driven by water power 4½ miles distant.

Vicksburg, Miss.—The Louisville, New Orleans & Texas R. R. has decided to light its shops, offices, and yards by electric lights, and will purchase a complete plant for that purpose.

SEWERAGE AND MUNICIPAL.

Sewer Bonds.—***Newburyport, Mass.***—The issue of $50,000 sewer bonds has been awarded to Adams, Blodgett & Co., of Boston, at $107.28.

Albany, N. Y.—The $90,000 bonds for the Beaver creek sewer have been sold as follows: Hudson City Savings Institution, $15,000; Albany County Bank, $25,000; E. M. Hahn, of New York, $50,000.

Street Work.—***New York, N. Y.***—Mr. GILROY, Commissioner of Public Works, has secured permission from the Board of Estimate and Apportionment to complete his arrangements for paving a number of streets with asphalt, over the present stone foundation, the cost of which will be about $100,000. The sum appropriated, in addition to that set aside at a previous meeting, $661,500, and $200,000 to be used on Mr. Stokes' Grand boulevard, with $25,000 for expenses, will just about use up this year's share of the $3,000,000 set aside for the purpose by the last Legislature.

Beatrice, Neb.—The city council has created a new paving district, to be known as district No. 4, which will comprise the territory on Court St., east of 15th St. The street will be paved with one layer of brick laid edgewise on a solid foundation of course sand. The curbing will be made of heavy oak plank.

Sewers.—***Nashua, N. H.***—The proposed sewar loan of $24,000 by the city was defeated by the Board of Aldermen on Aug. 27.

Flatbush, N. Y.—Mr. MCELROY, C. E., is making surveys for the purpose of establishing grades for the proposed system of sewers.

Seneca Falls, N. Y.—The contract for the completion of the Porter St. sewer has been let to Geo. Barlow, at $1,991.

Philadelphia, Pa.—The committee on sewers will apply for an appropriation of $667,640 for main sewers and $200,000 for branch sewers for the coming year. The items for main sewers are as follows: Tasker St., from 5th to 15th, $80,000; Shackamaxon St. outlet to relieve the Cohocksink sewer, $200,000; Shur's Lane, Cresson St. to Schuylkill, $7,100; Cresson St., Shur's Lane to Vassar St., $17,000; Manayunk connection to intercepting sewer, $25,000; Wissahickon branch of the intercepting sewer, $15,000; Wingohocking-Penn St. to Fishers' Lane, $120,000; Ashley and Pulaski Sts., $50,000; Frankford, $12,000; Mill Creek, $60,000; Ontario and Jasper Sts., $22,000; Somerset St., $171,000; 18th and Mifflin Sts., $8,000; Mill Creek outlet, $40,000; 52nd St. and Woodland Ave., $8,000; 46th St., $17,000; Miffin St., $25,000; Clearfield St., $20,000; 30th St., $15,000; 8th and Clearfield Sts., $50,000; 2nd and Lippincott Sts., $5,540.

Jackson, Tenn.—The City Council has decided to build the sewers in district No. 1 this fall. This district includes the business portion and the thickly settled residence portion of the town.

Ironwood, Wis.—It is proposed to issue bonds for $45,000 for a system of sewerage.

Los Angeles, Cal.—The city has made a contract to furnish Anderson Rose with not less than 1 cu. ft. of sewage per second from the outfall sewer crossing Mr. Rose's property.

WATER-WORKS.

NEW ENGLAND.

Milford, N. H.—Work has been commenced on the brick pumping station. Pipe-laying is nearly completed.

Beverly, Mass.—At a recent special meeting of the Town Council it was voted to extend water pipes through Bay View Ave. and Judson St. R. G. BENNETT, Town Treasurer, was also instructed to bring suit against the New England Construction Co., to compel them to live up to their bond given the town when the works were accepted.

Avon, Mass.—The contract for constructing a large well for the new works has been awarded to Geo. M. Atkins & Co., of Palmer.

Jamestown, R. I.—The Town Council has appointed T. C. WATSON to make investigations and report upon the question of establishing fire hydrants.

Windsor Locks, Conn.—Pipe laying for the new works is nearly completed. Workmen are now engaged in constructing the dam and erecting the stand-pipe.

MIDDLE.

Cuba, N. Y.—The new gravity system of works has been satisfactorily tested.

New York, N. Y.—Section 5 of the new aqueduct has been completed. The contract for laying out and constructing the roads and approaches of the East Branch and Bog Brook reservoirs has been awarded to Clinton Stephens, of Brooklyn, at $87,551.

Troy, N. Y.—A small amount of 24-in. pipe and a considerable amount of smaller sizes has been ordered laid, and several hydrants set. The water rates show a decrease of $7,947.82 from last year's rates.

Long Island City, N. Y.—The Westchester county bank has purchased $15,000 of 5 per cent. 30-year bonds, in denominations of $500 each, at $1.18.

West Troy, N. Y.—A 700,000-gall. tank is being erected by the Green Island Water-Works Co. It will be 80 ft. in diameter by 20 ft. high.

Hoosick Falls, N. Y.—Work is progressing rapidly on the dam being constructed across the Hoosick river for the electric light and water-power company. Brown Bros. are the contractors. LYMAN C. WILDER is the engineer in charge.

Albany, N. Y.—Additional land has been purchased by the contractors upon which they are to sink 16 wells to a depth of about 50 ft. A daily supply of about 2,000,000 galls. is anticipated from this source.——All proposals received for constructing the foundations for the new pumping-station have been returned to the bidders.

Syracuse, N. Y.—No action was taken at the hearing of the Canal Board at Albany, on Aug. 29, on the application of the city to utilize the water of Skaneateles lake, and the matter was adjourned to Sept. 23.

Newark, N. J.—The present supply is so unsatisfactory that, pending the completion of the new works by the East Jersey Water Co., several prominent citizens propose organizing a company to furnish water by the cartage system at 4 cts. per gallon. The REV. HORACE BARNES is interested in the project.

Atlantic City, N. J.—The Consumer's Water Co. has contracted with P. H. & J. Conlan, of Newark, for sinking an 8-in. artesian well to a depth of about 800 ft.

Easton, Pa.—A small independent system of works is being established at the county court house and jail. An artesian well has been sunk, and a sufficient supply of water obtained for all purposes. A stand-pipe is to be erected. A yearly rental of about $2,000 has heretofore been paid by the county for the jail's supply.

Allegheny City, Pa.—It is now reported that Superintendent EDWARD ARMSTRONG is soon to present two plans to the water committee for furnishing a pure water supply.

SOUTH ATLANTIC AND SOUTH CENTRAL.

Bon Air, Va.—The Bon Air Water Co. has been incorporated to construct works. Capital stock, $25,000. T. M. R. TALCOTT is President.

Richmond, Va.—A small amount of 16 in. pipe has been ordered laid, to replace the 6-in. pipe now being removed, on Broad St. Superintendent CHAS. E. BOLLING, in his report to the water committee, again recommends as a safeguard against future washouts from high water, the immediate appropriation of a sufficient amount to construct a large waste-way above the Five Mile lock, with waste-gates, and raise and strengthen the banks between the Three and Five-Mile locks; also to raise the masonry at Five-Mile lock to prevent too much water coming in from the Four-Mile level.

Cedartown, Ga.—The Cedartown Lumber Co. is to erect two 30,000-gall. tanks.

Macon, Ga.—The new reservoir is to have a capacity of 15,000,000 galls.——It is also reported that an English syndicate is negotiating for the purchase of the works.

De Land, Fla.—Plans for a $30,000 system of works have been ordered. They are to include about 5 miles of 12 to 6-in., mains, a pumping station, a 750,000-gall. reservoir and a steel stand-pipe. Address SILAS B. WRIGHT, City Clerk.

Florence, Ala.—A. E. BOARDMAN, of Jeter & Boardman, Macon, Ga., contractors for the new $250,000 works, is in the city locating the stand-pipe, pump houses, etc. Work will be begun in about 10 days.

Vicksburg, Miss.—The Louisville, New Orleans & Texas R. R. is to put in a complete system of works to supply its shops, depots, and offices. The right of way to take water from the river has been secured. A stand-pipe 90 ft. high and 12 ft. in diameter, and a pump house will be erected.

Chattanooga, Tenn.—The company is to increase its supply from an artesian well. The contract has been awarded to D. F. MCKEY, Somerset, Ky.

Nashville, Tenn.—The Peet Valve Co., of Boston, has been awarded the contract for furnishing several 36 in. valves.

North Knoxville, Tenn.—The Cook Well Co., of St. Louis, Mo., will probably sink an artesian well.

Covington, Ky.—The following bids have been received by Consulting Engineer GEO. F. BOUSCAREN, of Cincinnati, O., for completing the Covington reservoir: Jas. H. Harlow & Co., Pittsburg, Pa., $212,080; D. F. Minahan & Co., Springfield, O., $218,200; R. G. Huston & Co., Glendale, O., $225,488; D. Shanahan & Co., Richmond, Ky., $225,706; Sooysmith & Co., New York, N. Y., $226,142; P. H. Kelly Co., Portsmouth, O., $235,916; J. S. Casement & Co., Cleveland, O., $239,228; W. E. Dorwin & Co., Oswego, N. Y., $251,545; H. H. Squair, Cincinnati, O., $271,335.

NORTH CENTRAL.

Cleveland, O.—A 36-in. main is now being laid from the pumping station to the Fairmount reservoir. A tunnel under the Cuyahoga river will be constructed in connection with this work. The work will cost about $200,000. There is a general complaint at present of insufficient pressure.

Cincinnati, O.—Superintendent A. G. MOORE has recommended that contracts for constructing the Eden

park reservoir be awarded as follows: To J. H. Finnegan & Co., excavation, masonry, and brickwork, $21,740; David Hummel, cut stone work, $10,400; M. Clements, iron work, $3,241; Harwood & Son, wood work, $1,813, Witt Cornice Co., roofing (special), $2,655; Geo. Eichert plumbing, $595; Allan G. Meakin, painting, $495. Add plastering (not bid for) $145. Total cost, $41,082.

London, O.—A majority vote of 229 has been cast by the citizens in favor of ratifying the contract for new works with John P. Martin, Xenia, O. The system will consist of about 11 miles of mains, and 100 hydrants, for which an annual rental of $5,000 will be paid.

Madisonville, O.—The City Council has received a proposition from a company to construct works.

Indianapolis, Ind.— Judge MARTINDALE has addressed the Water Board upon the necessity of supplying the city with pure water, and asked to have a well bored to a depth of from 2,500 to 3,500 ft., at an estimated cost of $5,000. Several members expressed themselves as favorably inclined to such a scheme, one of them offering to donate $50 in promoting it. The matter was referred to a committee of five.

Tuscola, Ind.—The town is negotiating for a system of works.

Mio City, Mich.—It is reported that a small system of works is being constructed by the Mio Water Co. Secretary, JOHN RANDALL.

Monroe, Mich.—The new works will probably be completed in about 90 days. Work is progressing favorably.

Chicago, Ill.—The American Water-Works Co. has filed a certificate of increase of capital stock from $4,000,000 to $5,000,000.

Peoria, Ill.—Moffett, Hodgkins & Clarke, Watertown, N. Y., have purchased 60 acres of land, six miles from the city, for $7,000, on which they propose developing the water supply and erecting the new pumping station.

Princeton, Ill.—The town has voted to construct works costing about $30,000. The supply will be taken from artesian wells.

Washburn, Wis.—Works are now being constructed.

Antigo, Wis.—The Holly Mfg. Co., of Lockport, N. Y., is to make a proposition to construct works.

Oshkosh, Wis.—Complaints are being made of the quality of the present supply, and there is talk of the city purchasing the works from the company, and greatly extending and improving them.

NORTHWESTERN.

Iowa Falls, Ia.—The town wants works.

Sandstone, Minn.— Articles of incorporation have been filed with the Secretary of State by the Sandstone Water Co. The capital stock is $30,000. The incorporators are: WILLIAM H. GRANT, of St. Paul; WILLIAM H. GRANT, Jr., and JOHN E. JOHNSON, of Sandstone.

Chatfield, Minn.—An artesian well is to furnish the supply for the new works. I. H. DOUD is the contractor. Excavation for the 9,000-gall. reservoir will begin soon. The mains will be of 10 and 6-in. cast-iron pipe.

St. Paul, Minn.—At a recent meeting of the Water Board the right of way for 2¼ miles of new water connections between Charles and Baldwin lakes was approved, and the connection will be built at once. Baldwin is the first of a chain of lakes from which a large supply can be taken. The contract for making these connections and building a pump-house was let to McArthur Bros., at $14,967.50. For furnishing a 10,000,000-gall. pumping engine to the Deane Steam Pump Co., Holyoke, Mass., at $8,000.

Belleville, Kan.—The Belleville Water Light and Power Co., has been incorporated at Topeka; Capital stock $50,000. Directors: J. M. DOYLE, GEORGE W. COLLINS, E. A. HALLOWELL, F. H. SHERER, J. F. STATESMAN.

Seward, Neb.—Consulting Engineer A. A. RICHARDSON, of Lincoln, informs us that bids will be opened on Sept. 16 for constructing a $30,000 system of works.

Ainsworth, Neb.—A petition is being circulated asking the town board to submit the question of issuing $8,000 of bonds to put in a system of works.

Raymond, Dak.—A water supply for fire protection is needed, and an effort is being made to raise funds for obtaining it.

Elk Point, Dak.—Work has been begun on the artesian well.

Oakes, Dak.—W. P. BUTLER sends us the following:

A system of works is to be constructed. The supply will be taken from artesian wells. About 2,500 ft of 6-in. pipe will be laid, and 5 hydrants set this fall; additions for a complete system will be made in the spring. Engineer, W. P. BUTLER, Aberdeen, Dak.

Fort Yates, Dak.—JAMES MCLAUGHLIN, U. S. Indian agent, informs us that Fairbanks, Morse & Co., of Chicago, agreed to furnish the pump and tank for $1,600. A water supply is to be established.

Helena, Mont.—No decisive step has been taken, but it is probable that the city will let the contract for complete works to some reliable company. The committee is still open to new propositions.

SOUTHWESTERN.

Eagle Pass, Tex.—The works constructed by the Eagle Pass Water Supply Co. are to be extended to connect with a system for the city of Porfirio Diaz. A 2,000,000-gall. reservoir is to be constructed in Eagle Pass, and pumping machinery, of considerable capacity, is wanted. Address F. H. HARTZ, President.

El Paso, Tex.—The City Council has passed an ordinance to submit the question of issuing $25,000 of bonds for securing a new water supply to the tax-payers of the city. A vote will be taken about Sept. 20. In the meantime it is proposed to have experts make examinations, and to begin correspondence with reliable contractors.

San Angelo, Tex.—It is reported that the Artesian Water Co. is to construct works, and wants propositions for sinking a well.

Martin, Tex.—A water supply costing about $6,000 is to be constructed.

Erie, Col.—A gravity system of works is projected. A. M. VAN AUKEN, of Denver, is the engineer.

La Cruces, N. M.—A proposition will soon be made to the people to supply the city with water from a 3 in. artesian well for $5,000. It will probably be accepted.

Albuquerque, N. M.—The City Council has passed an order directing the company to comply with its charter and in case it does not threatens to forfeit its contract.—A later report states that a daily supply of 140,000 galls. has been obtained from the 3-in. artesian well, and that another one is to be sunk at once.

PACIFIC.

Moscow, Wash.—The town has issued $30,000 of bonds for works.

Cheney, Wash.—A contract has been let for works to be completed this year.

Port Townsend, Wash.—The new works will cost about $200,000. Work will be begun about Jan. 1, 1890.

West Seattle, Wash.—The new works will have a daily capacity of 500,000 galls.

Seattle, Wash.—BAILEY GATZERT, President, in a letter to the City Council states that the company prefers not to sell its plant at the present time, and offers for a ten years' extension of its franchise so to enlarge and improve its system as to make it in all respects sufficient to the public needs.—JOHN W. HILL, of Cincinnati, O., has been engaged as Consulting Engineer.

Ellensburgh, Wash.—The City Council will probably contract with the Holly Mfg. Co., of Lockport, N. Y., for a $60,000 system of works.

Uniontown, Wash.—The city has been contemplating putting in a system of works for some time. Action will probably be taken soon.

Mount Vernon Wash.—A company has been incorporated, with a capital stock of $25,000, for the purpose of devising means to furnish the city with water and protection in case of fire.

McMinnville, Ore.—E. BARNEKOFF, Chairman Committee of Ways and Means, will receive proposals until Sept. 20, for $20,000 of 6 per cent. twenty year bonds, interest payable semi-annually.

Albina, Ore.—The following recommendation from the Fire and Water Committee has been accepted by the City Council:

For the water company to sell their entire plant to the city of Albina, or sell their mains, pipes, etc.; the water company to furnish the water, and supply all mains, pipes, etc., for a period of five years.

The first proposition to sell the entire plant for $20,000, the second to sell for $15,000.

Also that the decision be left to the taxpayers of the city, and that an election be called for the purpose of ascertaining whether bonds shall be issued for the purpose of maintaining water-works or not.

Baker City, Ore.—Artesian wells are to furnish the supply for the new works.

Santa Ana, Cal.—The contract with Mr. HEDGES calls for works costing $100,000. Water will be pumped from the Cole artesian well by a 3,000,000-gall. pumping engine. About 14 miles of pipe will be required.

Oakland, Cal.—Messrs. ROSS, BROWNE, HILGARD, and HESSE, have recommended to J. W. MARTIN, of the Board of Public Works, that a supply of water for domestic purposes be obtained by sinking several groups of wells in different places, and forcing the water to stand pipes It is estimated that 2,500,000 galls. of water are used daily for domestic purposes. The estimated cost of the plant is $500,000.

San Diego, Cal.—It is reported that the San Diego Water-Works Co. has sold its plant to an English syndicate for $1,400,000.

Los Angeles, Cal.—The City Attorney in his report to the City Council states that the company has failed to supply a sufficient amount of water, and recommends that action be taken to forfeit the company's lease, and that other arrangements be made for the city's supply.—A meeting has since been held at which the company stated new pumps had been ordered from Crane Bros., of Chicago, and were now on the way. Also that, if necessary, new mains would be laid, and the size of the reservoir increased.

Ogden, Utah.—Engineers are now making the preliminary surveys for the new works.

CANADA.

Yarmouth, N. S.—GEO. H. ROBERTSON, Superintendent, informs us they are building a new gate-house, and laying new mains.

Cote St. Paul, P. Q.—Works are to be constructed. Plans and specifications can be obtained from A. D. AUBRY, Secretary.

London, Ont.—Sources for an additional supply are being investigated.

Campbellford, Ont.—JOHN GALT, of Toronto, Engineer for the new works, informs us that the contract for complete works has been awarded to Miles Hunting & Co., of Hamilton, at $19,500.

Chatham, Ont.—N. H. STEVENS, President of the Board of Trade sends us the following:

The question of constructing works has been discussed by the Board of Trade, and a resolution adopted recommending the council to take steps to secure plans and the cost of supplying the town with water by the driven well system.

ARTESIAN WELLS.

Monticello, Fla.—The citizens propose sinking a well. Address the Town Clerk.

St. Paul Minn.—Two wells have been sunk in Como park, on Indian Point. In one, 200 ft. from the lake, water rose 12.03 ft. above the lake level, at a depth of 42 ft. In the other, about 3,000 ft. from the lake, it rose 8 ft. above the lake, at depth of 61 ft. Additional wells will be sunk if this rise of water proves permanent.

Roscoe, Dak.—A well sunk by Mr. HOPKINS, near this place, has proved successful at a depth of 200 ft.

Fields City, Dak.—A well has been sunk.

Miller, Dak.—A good supply of water is being obtained from the new well.

Dakota.—Petitions to Congress for an appropriation for sinking wells are being circulated in Dickey county.

Yankton, Dak.—Z. RICHEY, Secretary Board of Hospital Trustees, informs us that all bids for sinking the well were rejected.

Taylor, Tex.—It is reported that the capital stock of the Taylor Artesian Well Co, is $50,000, instead of $5,000, as previously stated in these columns.

Dunmore, N. W. Ter.—A company is sinking a well.

Colfax, Wash.—The City Council has let a contract to bore a deep well on the pesthouse property.

Emerson, Neb.—The railroad well has been abandoned at a depth of 688 ft.

Spencer, Ind.—A well is being sunk.

Baker City, Ore.—A good supply of water has been secured by Mr. TWISS at a depth of about 300 ft.

Oregon and Eastern Washington.—The Portland *Oregonian* states that several wells have been sunk in Pullman and vicinity, and more are projected. The water is pumped by windmills.

IRRIGATION.

Santa Fé, N. M.—The geological survey has located a national reservoir district in New Mexico, along the Jemez valley, extending south and including Albuquerque. Maps of the district are on file in Washington. The land included in the Jemez survey covers townships 9 to 15 inclusive, ranges 1 west and 1, 2, 3, 4 and 5 east. It runs 12 miles east and 12 miles west of Albuquerque, and 3 miles south and about 40 miles north.

Carson City, Nev.—The line of the proposed tunnel surveyed by Col. BRIDGES to tap Lake Tahoe for the purpose of supplying water for operating machinery and other purposes, will be about 4 miles long. It will tap the lake at a depth of 20 ft. below the surface.

Fort Morgan, Col.—Contracts have been awarded for constructing the dams, flumes and headgates for the Bijou Reservoir & Canal Co.'s ditch, aggregating about $8,000. A large area is to be reclaimed by this canal; part of it this fall.

Granite, Mont.—A certificate of incorporation of the Fred Barend Granite Ditch Co. has been filed with Secretary WALKER, of Helena. The incorporators are WM. C. BUCKETT, WM. D. DODDS, A. J. BETTHO, and JOHN H. HENEY. The company is capitalized at $50,000, divided into 10,000 shares.

Greeley, Col.—The Greeley Irrigation Pump Co. is now in operation.

Gering, Neb.—The Scott's Bluff Irrigating Co. has been organized. Capital stock, $500,000. Work on a large canal will be begun in about 90 days.

ANNUAL REPORTS.

We desire to receive the printed annual reports of every water-works in the country. Those sent in will be acknowledged here, and further use will be made of them in "The Manual of American Water-Works" for 1889.

Reports from the following places have been received since our last acknowledgement:

Massachusetts.—Adams; DANIEL UPTON, Treasurer, Lynn; Superintendent, DANIEL WALDEN.

Rhode Island.—Woonsocket; Superintendent, WILLARD KENT.

New York.—Troy; Clerk, GEO. B. FALES. Yonkers Superintendent, JOS. A. LOCKWOOD.

New Jersey.—Trenton; Secretary, CHAS. A. REID, Woodbury; City Clerk, SAML. B. BURKETT.

Pennsylvania.—Harrisburg; President Commissioners, EDMUND MATHER.

Michigan.— Kalamazoo; Superintendent, GEO. H CHANDLER.

Illinois.— Aurora; City Clerk, J. M. KENNEDY. Springfield; City Clerk, GEO. HOFFERKAMP.

Texas.—Dallas; Superintendent, DAVID TICHENOR.